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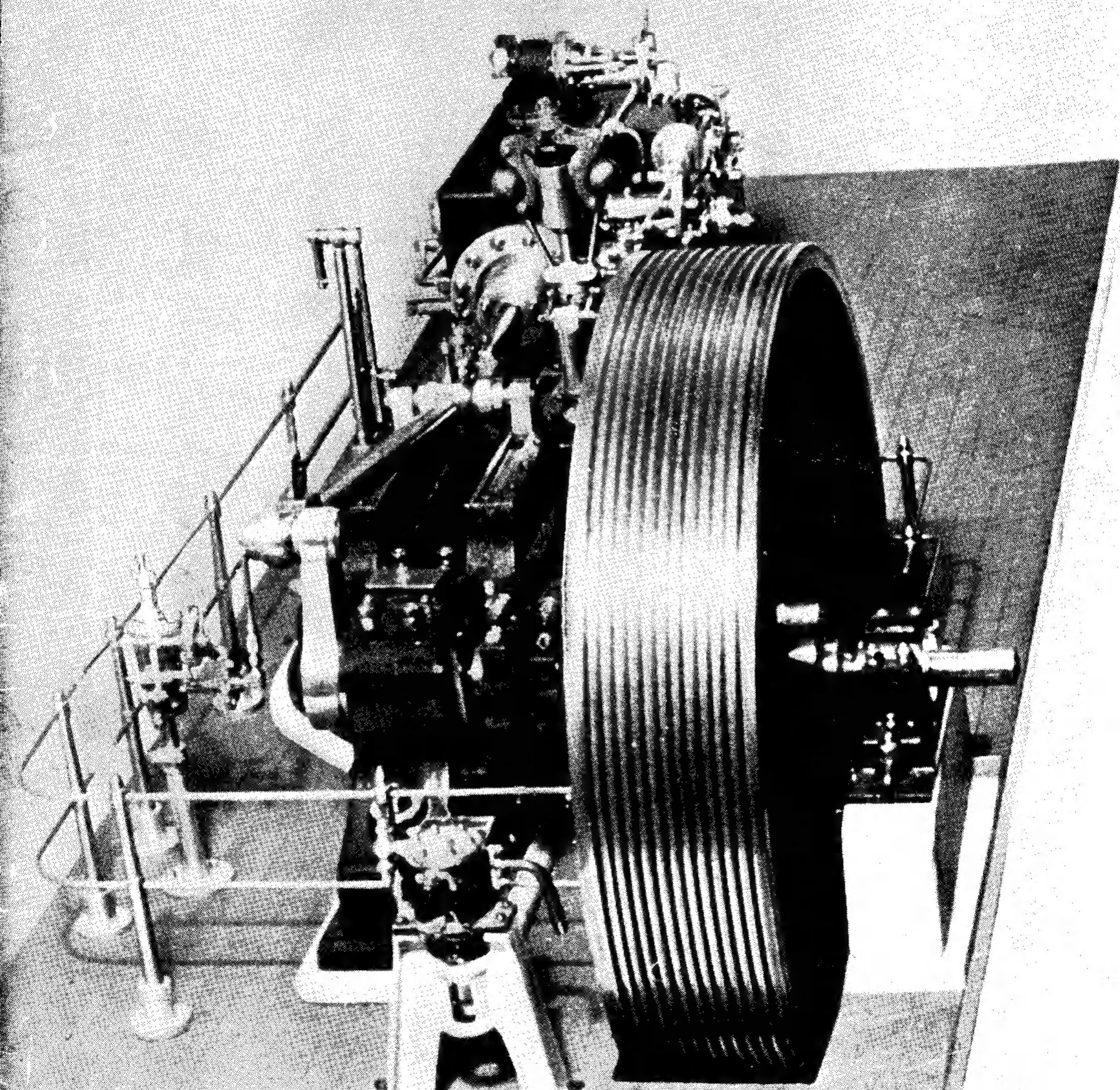
THE MODEL ENGINEER



The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, GREAT QUEEN ST., LONDON, W.C.2

15TH NOVEMBER 1951 VOL. 105 NO. 2634

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SMOKE RINGS

Our Cover Picture

● ONE OF the outstanding exhibits at the recent show at Leeds was this magnificent Corliss engine by Mr. Amos Barber. Although not quite complete, it was awarded the Members' Prize. The barring engine, seen in the foreground, has still to be finished, as has the indicator gear, part of which is seen at the left-hand side just forward of the cylinder.

Further details of this engine are given in a description of the exhibition itself in this issue.

Growing Larger

● THERE SEEMS to be a tendency, today, for some enthusiastic model engineers to aspire to building "models" in larger scales than hitherto. This is especially apparent in miniature steam locomotives; until a few years ago, $2\frac{1}{2}$-in. gauge was at the head of the list, in popularity, for steam passenger-haulers, but it has now given way to $3\frac{1}{2}$-in. and 5-in. gauges. There is also a steadily-growing interest in $7\frac{1}{4}$-in. gauge, especially among those enthusiasts who have the means and facilities available for the building, operating and maintaining of engines of this size.

Much the same story can be told of miniature traction engines; the 1-in. scale seems now to be giving way to $1\frac{1}{2}$-in. and 2-in. scales, both of which have quite a large following at the present time. The 3-in. scale, or a quarter of full size, is not unknown for traction engines, but we wonder if there is, as yet, a rival to the one-third full-size engine being built by Mr. Wightman, of the Manchester S.M.E.E. We can well imagine that there are only very few readers who possess equipment to enable them to construct such engines to so large a size, but we are not certain that Mr. Wightman is the only one! Good luck to him, and we hope to be able to illustrate his engine, in due course.

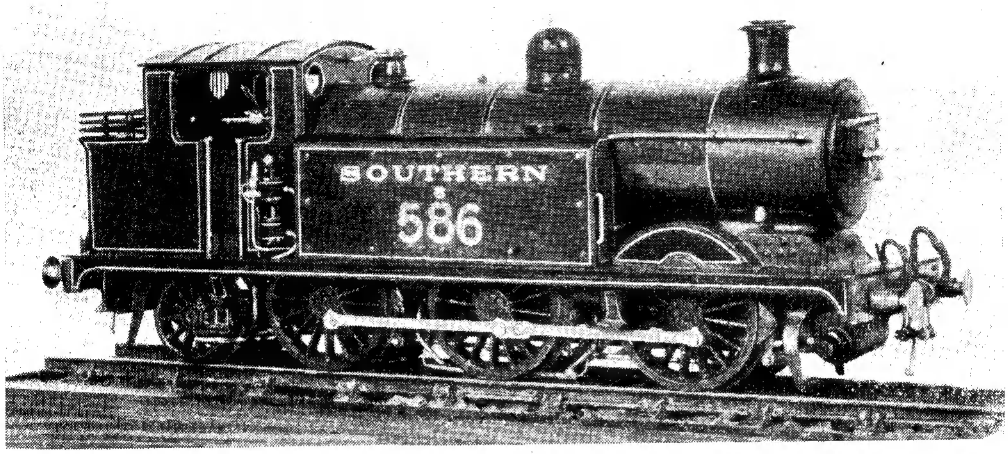
An explanation of this tendency to enlargement, may be found in the everlasting desire to obtain more power for the work to be done; and there may be, at the same time, more than a modicum of self-satisfaction to be felt by anyone who succeeds in producing a really large-size "model." But where is this tendency leading us? Is it not overstepping the borderline between "model" and "prototype"? If the tendency continues to grow, the inevitable and logical goal must be that somebody will, in due time, produce a *full-size* model! So what?

The chief attraction of the miniature is that it *is* a miniature, and if it is steam operated, its output of power seems out of all proportion to its size; as the scale increases, the disparity appears to diminish, and the fascination, thereby, is lessened. So there is some reason for expressing the hope that the urge for working in larger scales will not get out of hand; if it does, the chances are that the word "model," as it is generally understood, will cease to have any meaning.

An Interesting Modification

● "L.B.S.C.'s" "O"-GAUGE 0-6-0 tank engine *Mollyette* has been, and still is, a very popular little live-steamer with those enthusiasts who have very meagre workshop facilities and, therefore, require a little engine that can be built out of next to nothing while, at the same time, giving a good performance on the track.

However, there have been some keen readers who have looked beyond these possibilities and have seen the chance of using *Mollyette* as the foundation on which to build up a little steam locomotive that will not only be as successful a performer but will really look like some definite prototype.



The best effort of this kind that has yet come to our notice is the one illustrated in the photograph reproduced on this page. It was built by Mr. W. F. Gentry, of Bristol, and represents the L.B. & S.C.R. Class "E5X" class 0-6-2 tank engine, No. 586, painted in Southern Railway passenger engine livery.

Basically, the engine is *Mollyette* except that the boiler has a central flue, thus making it semi-internally fired, and this has proved a great help in raising and maintaining a good head of steam. Mr. Gentry writes: "The working pressure is 45 lb. per sq. in. Spirit is carried in the bunker and feeds the lamp through a float-operated valve, while the displacement lubricator is fitted with a motor-cycle grease nipple. By pressing the ball inwards, the water is blown out, and the container can then be refilled with a grease-gun while the engine is in steam. The drawing was worked up from an F. Moore's coloured postcard, with the aid of some dimensions kindly supplied by Mr. J. N. Maskelyne."

The wheels, which are commercial iron castings, and the superstructure are to 7-mm. scale; we think that the result is excellent as a scale reproduction of the prototype, externally, and it shows what can be done by a determined enthusiast. We feel it advisable, however, to add that, in cases of this sort, the greatest success is obtained from the simplest prototypes; Mr. Gentry's choice was admirable in this respect.

The Hitchin Exhibition

● THE HITCHIN and District Model Engineering Club held their third exhibition in the New Town Hall, Hitchin, in October. The attendance was slightly lower than last year, but about three thousand saw the efforts of modellers from Hitchin and its surrounding districts. The standard of the exhibits was the highest seen in Hitchin, and nearly fifty models were entered for the various competitions. The judges, Mr. L. Rose, Mr. Wright and Squadron Leader Hardstaff had the most difficult task of all.

Among the many exhibits, it is only fair to mention the comprehensive "OO" layout of Messrs. Downs & Keith, of Hitchin, which has been constructed entirely at a very minimum of cost, only the locomotive motors and the rails being purchased; the Marblehead yacht of Mr. Wood, of Bedford, was a very close contender in the "open," as also was the 0-4-0 saddle-tank of Mr. Dennis, of Harlesden, and the diesel yacht *Lady Marion* of Mr. Mardlow. Mr. Vandyke's "Daytona" motor yacht *Pat* was much admired, as were the uncompleted 4-4-0 narrow gauge locomotives, *Polar Bear* and *Polar Seal*, of the Brothers Frost, of Stevenage.

Again, a main centre of attraction was the club's "O" gauge layout; this has been altered, by the addition of a high-level section, which will eventually form the tunnel and will contain the turntable, coaling station, locomotive sheds, etc. The whole layout is to be completely electrified and controlled from the "organ" controller which has been designed and built by Mr. Wilman and his helpers.

The cups and medals were presented by the chairman of the Hitchin Urban District Council, Councillor F. O. Foster, who in a few appropriate words, congratulated the club on the presentation of the exhibition and thanked the members for their effort towards the Hitchin Festival of Britain, during which the club built and manned the replica of the first engine to run into Hitchin.

The club committee wishes to place on record its sincere thanks for the modellers' ladies for their unstinted labour at the refreshment counter for so many hours.

THE CITY OF LEEDS S.M.E.E. EXHIBITION

by W. J. Hughes

THERE were many fine models at the 1951 Leeds exhibition, and it is not an easy matter to choose a representative selection to describe here. I hope, therefore, that those whose excellent models are not mentioned will forgive me, and ascribe the omission to that enemy of all journals, lack of space.

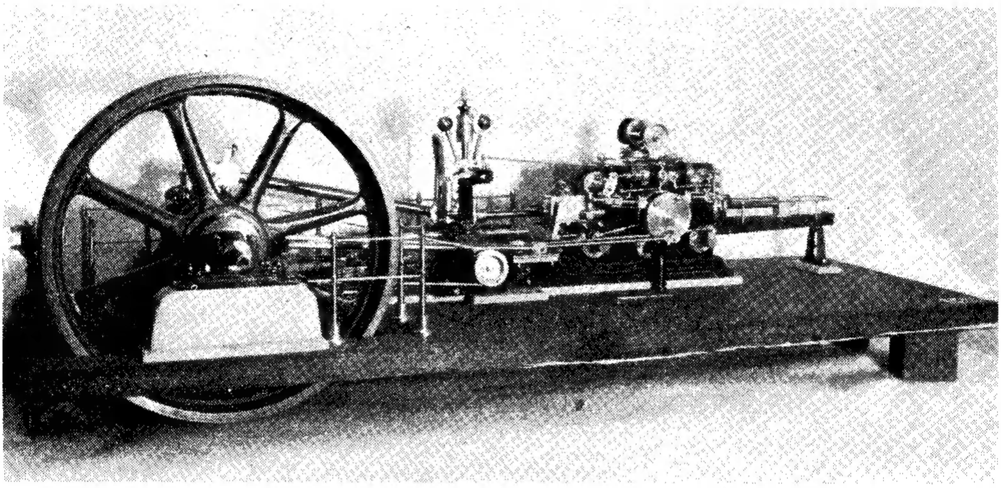


Photo No. 1. A side view of the horizontal mill-engine, with Corliss valve-gear, built by Mr. Amos Barber; a further photograph of the engine appears on the cover of this issue

The model which won the "Members' Prize" was the beautiful mill engine built by one of the North's outstanding model engineers, Mr. Amos Barber. (Readers will no doubt remember his complete Crossley diesel engine-room model described some time ago in THE MODEL ENGINEER.) As seen in the photographs, the mill-engine is fitted with the very fascinating Corliss valve-gear, so lovely to watch in action—and also to listen to. The engine is not quite complete, as the tiny single-cylinder barring-engine lacks some of its parts, and Mr. Barber is also to fit indicator-gear: the baseboard has to be finished, too. Construction of the model has occupied about 2½ years up to the present, and the builder expects that completion will take about another three months.

From Pencil Sketches

Mr. Barber built the engine having in mind a prototype which he used to visit often as a boy, nearly sixty years ago, but which was scrapped some time since. The only drawings made were pencil sketches, but the proportions are excellent and the detail superb. As for the "finish," those familiar with the gleaming rods and polished paintwork of Northern engine-tenters would agree that this model is typical of the prototype. In fact, it would be difficult to find a point of criticism, though Mr. Barber tells me that probably his severest critic is his father, now in his ninety-ninth year!

Another of Mr. Barber's models—there were several in the show, including the engine-room model previously mentioned—was a small and lovely beam-engine, which was mostly built on the kitchen table. The model is only about 8 in. tall, and the fineness of some of the detail parts in valve-gear, governor-gear, and parallel motion is a joy to the eye. It is typical of the builder's enthusiasm that all the nuts on this model were filed up from round rod. Nor, incidentally, is the excellence of Mr. Barber's models an achievement only acquired lately, for a small traction-engine built by him over 48 years ago was on show, and vied in excellence with his later productions. It is of an early showman's engine, without canopy and fitted with the old-type open vertical dynamo.

A Contractor's Locomotive

The very fine locomotive shown in Photo No. 3 is a 3½-in. gauge contractor's engine, built by Mr. L. R. Raper. It is the builder's own design, but no drawings were made except for a sketch to work out valve-gear dimensions. Actually, it was "built round a pair of cylinders," to quote Mr. Raper, and there is about two years' work in the engine. Entered in the 1951 Northern

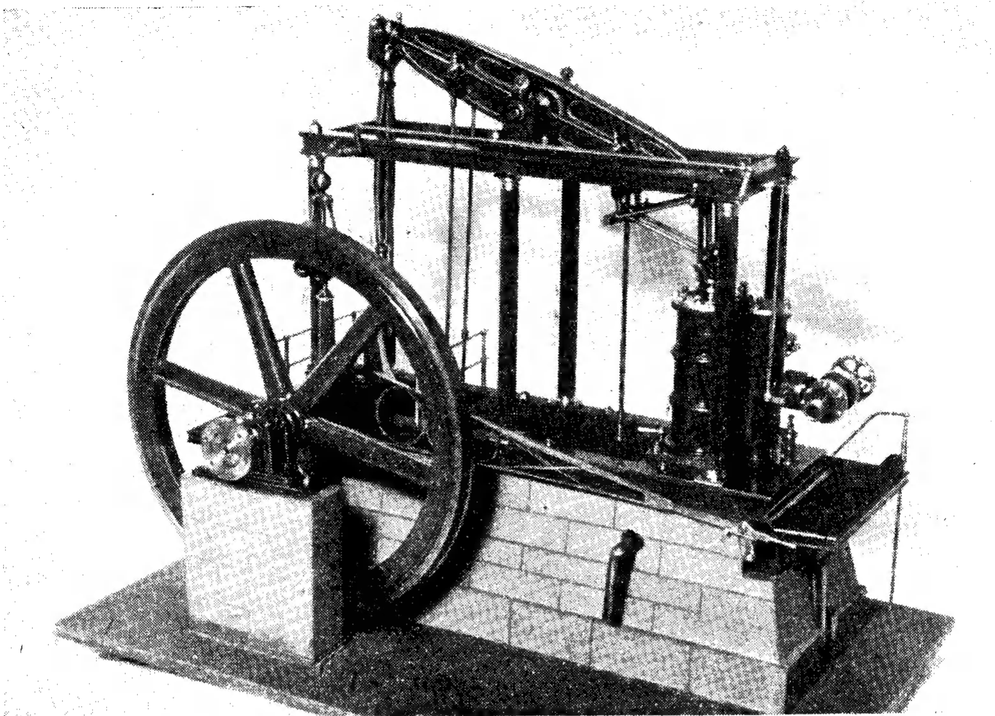


Photo No. 2. Another of Mr. Barber's exhibits was this small beam-engine, much of which was actually built on the kitchen table

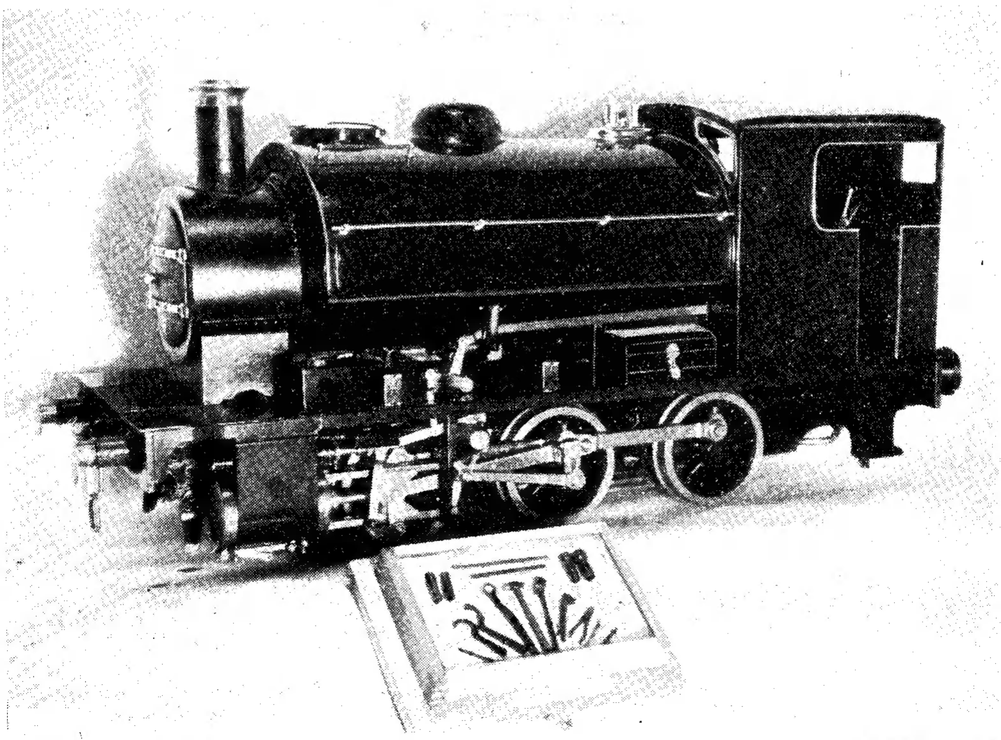


Photo No. 3. A lovely contractor's engine by Mr. L. R. Raper, one decorative feature of which was the complete kit of tools. The tiny padlock on the tool-box, just above the running-board, was a working *model, too*

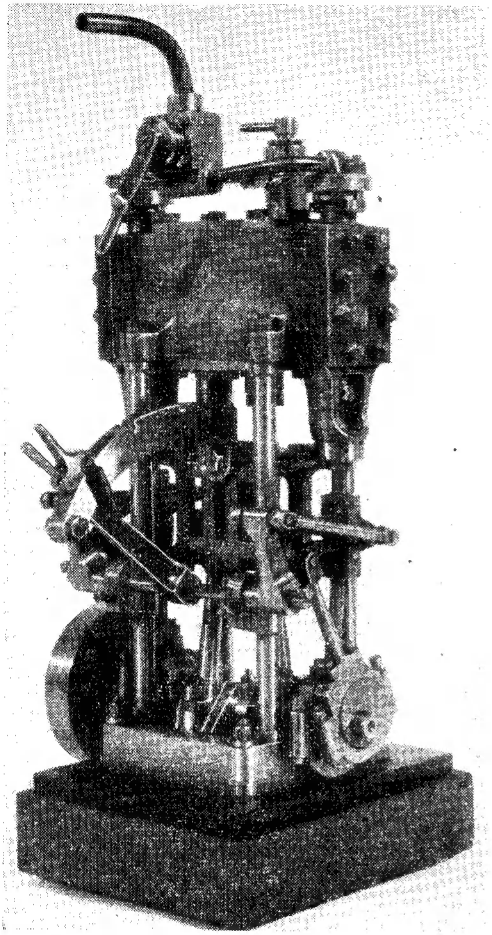


Photo by] [*Dewhirst Newsphotos (Leeds)*
Photo No. 4. Mr. S. Mitchell's two-cylinder launch-type engine was well-fitted and nicely finished

Models Exhibition at Manchester, she won the Championship Cup—an honour which Mr. Raper also achieved in 1949, incidentally.

Good Painting

The paintwork on this engine was among the best I have seen for some time, and I hope that many of the other exhibitors took note of it! For at Leeds, as in London, a good number of excellent models were spoiled by painting—a fact which caused hard words among the judges. In Mr. Raper's opinion, with which I heartily concur, nothing can beat brush painting. The secret is plenty of coats and plenty of rubbing down—and a modicum of patience. But what a difference!

Faults

Talking of faults, by the way, there were several examples of bad lettering, and quite a number of countersunk screws vaunting themselves in places where they had no business to be. Heaven knows why, after all that has been said about these bloomers in the past!

Returning to a pleasanter subject, Mr. Raper's locomotive which won the Northern Championship Cup in 1949 was nearby. This is a $2\frac{1}{2}$-in. gauge 4-6-0 free-lance mixed traffic locomotive, built to L.M.S. outline, but with two cylinders and Baker valve-gear. The successor to the contractor's engine, by the bye, is a 5-in. gauge version of a Lancs and Yorks "Aspinall" 0-6-0 goods engine, which I look forward to seeing in due course.

The Junior Prize was awarded to 17-year-old David Dobson, of York, for his "Juliet" tank-engine to "L.B.S.C.'s" design. This was a very creditable effort though I would suggest to David that *painting* flutes on connecting-rods is not to

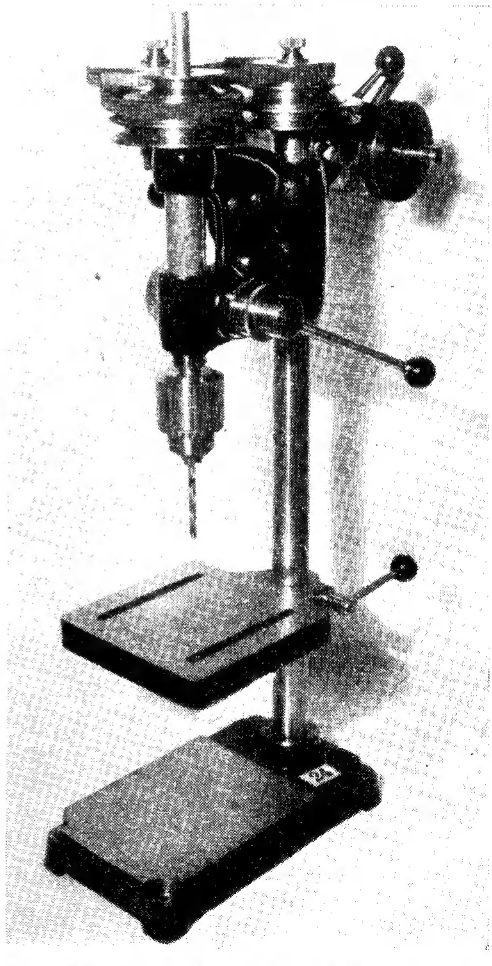


Photo No. 5. A Cowell $\frac{3}{8}$-in. drilling-machine, equipped with "back-gear," and built by Mr. J. Nichols. A feature of this machine was the excellent finish of the cast-iron parts

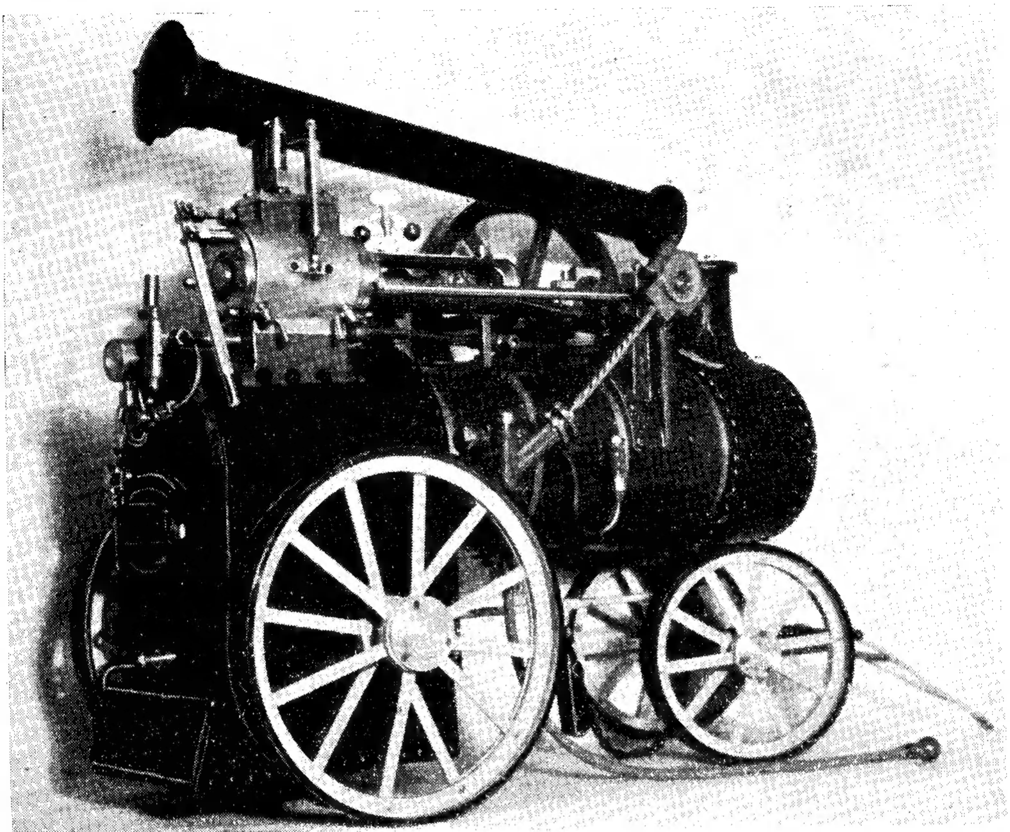


Photo No. 6. A portable engine makes a good working model, since the boiler and engine are together. This example is by Mr. A. Aston

be encouraged—nor, for that matter, are aluminium rods!

Stationary Engines

A very fine exhibit was a colliery winding engine, complete with headgear and boilers, by Mr. F. D. Woodall, of Leeds, who excels at this sort of work, of course. Another historical model was Mr. J. G. Wilson's Watt rotative beam engine of the 1790 period, which was fully described in THE MODEL ENGINEER some twelve or thirteen years ago. This model really does look as if it might be a century-and-a-half old, with its weathered oak beam and its cunningly rusted and blackened metal work.

Shown in Photo No. 4 is the twin-cylinder launch-type engine built by Mr. S. Mitchell, who is past his three-score and ten but who has only taken up our hobby within the past few years. Although this engine moved at the touch of a finger, there was no trace of sloppiness or slackness anywhere—a real tribute to the workmanship of the builder.

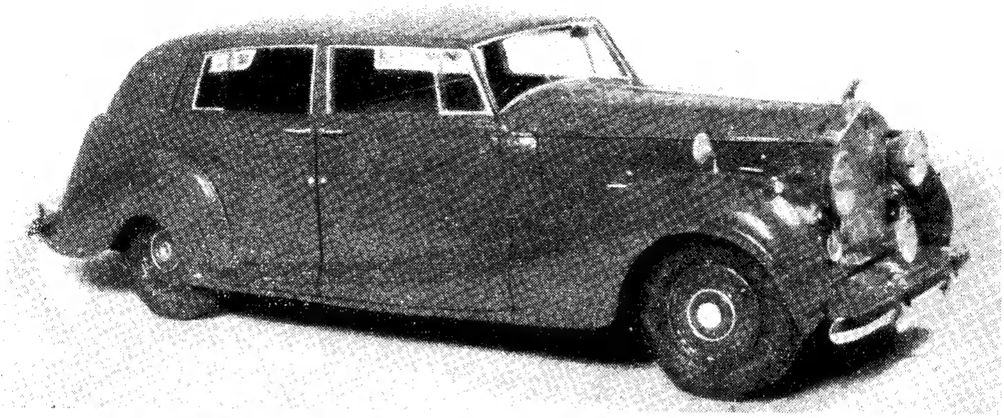
Workshop Tools

A very solid milling-slide for the lathe was shown by Mr. J. Hainsworth, of the parent society, and one would imagine that he will not be troubled by vibration when it is in use. But after due consideration, the judges awarded the prize in this class to Mr. J. Nichols for his $\frac{3}{8}$-in. bench drilling machine. This was built from Cowell castings, and is shown in Photo No. 5. The finish was excellent, and so was the fitting, the action being smooth and easy but without a trace of shake. A very useful tool indeed.

A Portable Engine

Mr. A. Aston was disarmingly self-critical over his portable engine (Photo No. 6), which is of free-lance design. Certainly, it had its faults—which the builder himself pointed out with gusto—yet it was obvious that he had had great fun in building and running it. His steam fire engine, too, was in the same category, and I noticed many people admiring this replica of a relic of days that are gone.

Other models there were good and not so good, but enough has been said to show that the Leeds exhibition was well worth visiting. In fact, I personally would have travelled as far just to see the Corliss engine and Mr. Raper's contractor's locomotive!



Right-hand side view of model based on James Young four-door sports saloon

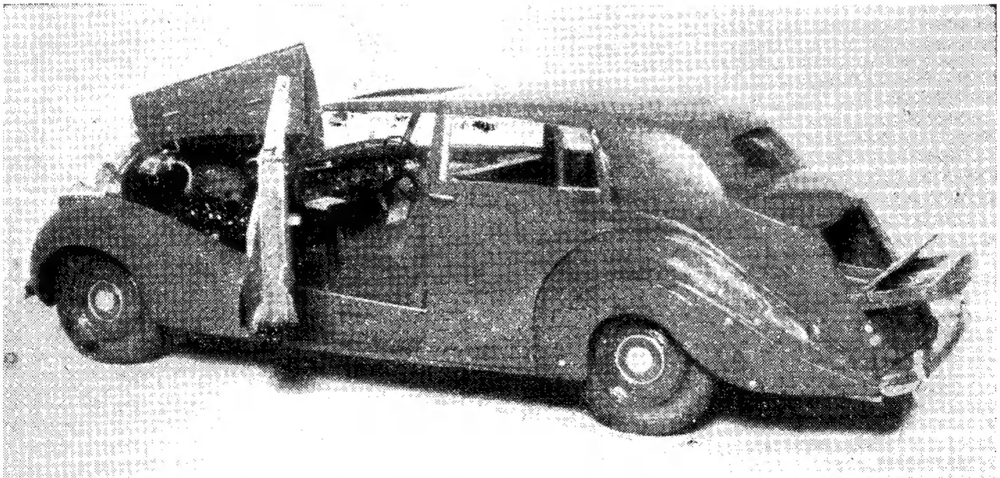
A One-Eighteenth Scale "Silver Wraith"

by Glenn N. Adams, M.Sc., (Montreal)

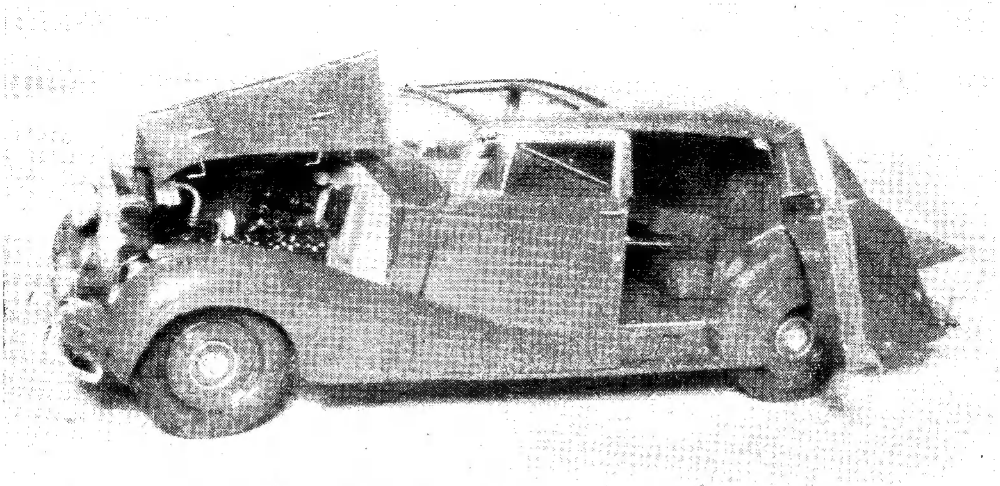
ALTHOUGH the model was completed in May, 1949, I have only recently succeeded in obtaining a satisfactory set of photographs. Simultaneously, I received the August 30th issue of THE MODEL ENGINEER containing a picture of Messrs. Dagnall and Hamilton's touring limousine, so I decided I had better hurry if I were not to be scooped completely.

The model contains about 1875 parts and took 350 hours to build, over a period of slightly less than one year. The scale being 1 in. to 18 in., the car is roughly 12 in. long, 4 in. wide, and $3\frac{1}{2}$ in. high. The chassis was built completely before the body was begun, working from photographs and perspective drawings appearing in *The Motor*. Only a few dimensions were known, such as wheelbase, track, and radiator and steering column size and location. The main side and X members are of 1/32 in. sheet brass for rigidity; the remaining structure and mechanical components are of wood, cardboard, brass, aluminium and miscellaneous wire.

Motor, clutch, and gearbox were carved from basswood. The scuttle was made of cardboard, and the radiator was soldered up from sheet brass. The mascot was carved from solid brass with the help of files and dental burs. (These are very cheap, by the way—no need to beg



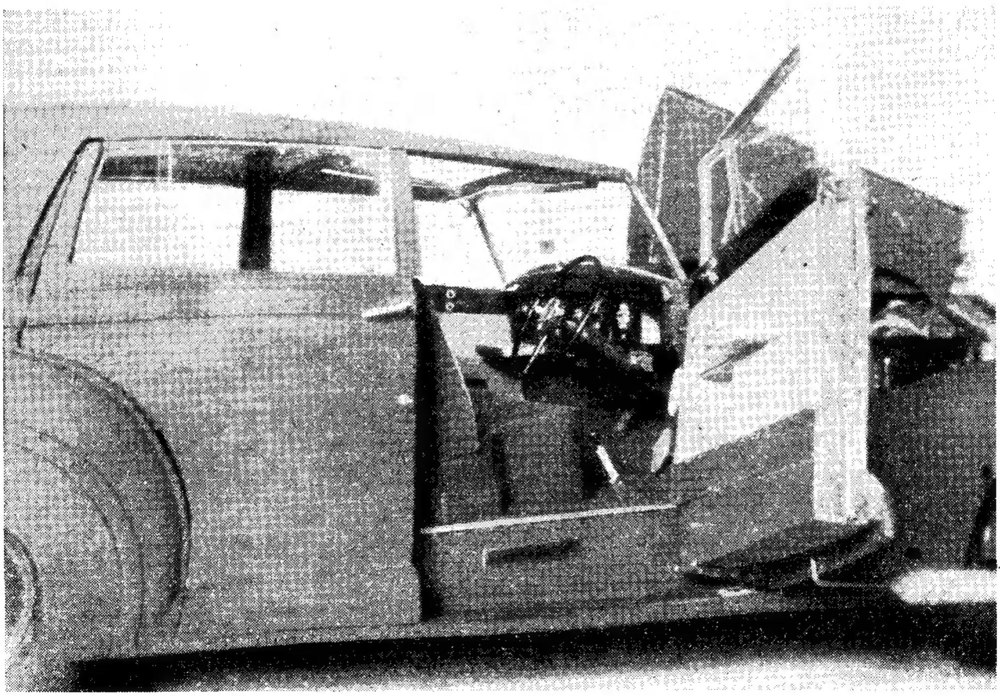
Left-hand side view, showing motor instrument panel, and luggage compartment. Note the tool trays



View showing motor and rear seat, including writing table. The buttons on the waist rail represent electric window controls

second-hand ones from the dentist. I buy British-made burs at 40 or 50 cents. per half-dozen). Since I did not have access to a lathe at that time (I have just bought one), the wheels are wooden ones, whose size determined the scale of the model, with wire and paper rings added to represent the disks. The chassis itself contains 750 pieces.

The body is based on the four-door sports saloon built by James Young Limited, who were kind enough to supply me with a large outline drawing. It would otherwise have been almost impossible to obtain correct contours. The body was carved from solid basswood blocks : for example, each fender is one piece of wood. (I note that Messrs. Dagnall and Hamilton built



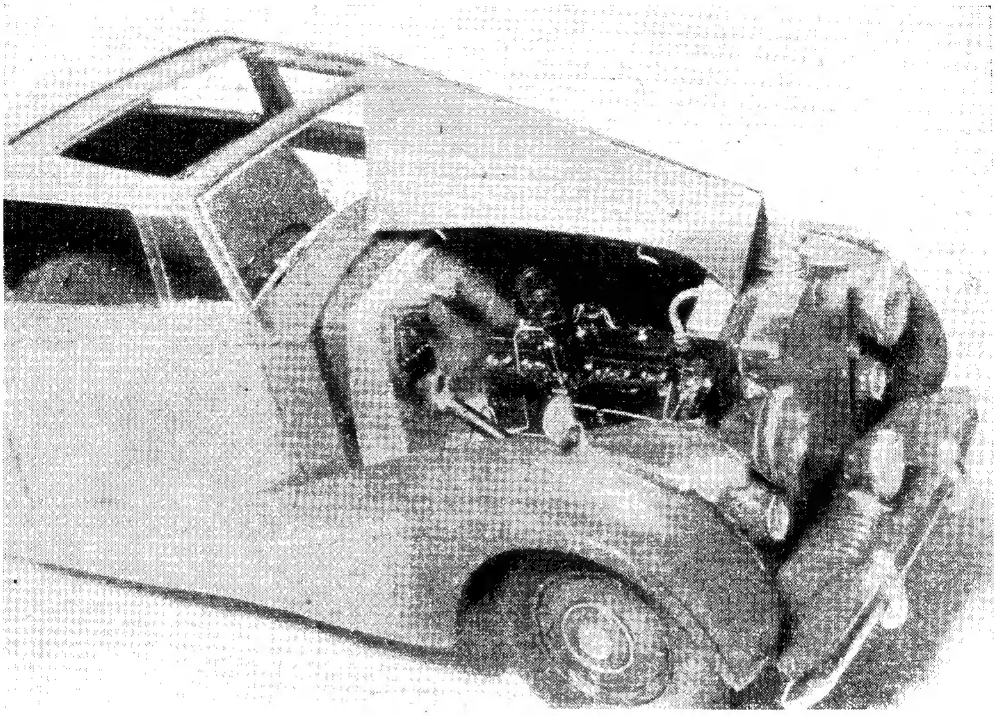
Driver's seat and controls

their body of sheet balsa, which looks quite satisfactory in the photograph. I wonder what procedure they recommend for producing a smooth finish on balsa wood ?) The roof, which, of course, was not made until the interior was complete, is of a double metal construction built up with plastic wood, in order to provide clearance and tracks for the metal sliding panel. I considered making a folding *de Ville* type roof, but thought better of it !

The bonnet was made of shim brass with the edges rolled over a wire to form piano type hinges. The headlamps were cast and filed (no lathe, remember) of solder. The bumpers, which were filed from brass sheet, the radiator, and the lamps were chrome plated commercially.

Very few pictures of the interior of the original could be found, so I took the liberty of arranging things to suit myself, while conforming to those details of which I did have pictures. The upholstery was made of paper painted in two shades of green to represent a plastic material. This is not a notable success. The carpet of dark green dyed flannelette is more satisfactory. After a fruitless search for suitably grained veneer, a close inspection of some of my basswood revealed a very fine figuring. When stained walnut this was used very effectively for the instrument panel, waist moulding, cabinet, etc. The sponge rubber seats are provided with folding arm rests. Glove compartment and writing tables open on wire hinges and are provided with spring catches. A sliding tray at the left of the instrument panel contains a set of tools. More are contained in a tray in the lid of the luggage compartment.

The wire forming the door handles is doubled back to form a cam which acts against a music wire arm whose end is bent over to form the latch.



Right-hand side of engine and scuttle

The instrument dials were drawn with a 7H pencil on tracing paper under a magnifying glass, and then printed photographically to give white letters on a black background. It would have been more sensible, if less honest, to have the dials drawn in black ink about 10 times the desired size and photographed them. The indicator needles are lengths cut off a painted hair. The nameplate on the radiator is a negative glued on to the metal.

The pictures were taken by Professor A. G. Lane, one of my colleagues at the Gas Dynamics Laboratory of McGill University. He used a Kodak Duo 620 with 75 mm. focal length, and a 1 diopter auxiliary lens, focussing at 50 cm. The exposure was 1/50 second at f/32.

I am just beginning construction of a one-tenth scale model of the left-hand drive " Silver Wraith " chassis (no body contemplated). This will give a rather large model, but I hope to make operating control linkages, and even with this scale I shall have to make several levers less than a ¼ in. long, to say nothing of 0.05 in. overall diameter ball and socket joints. The most difficult section will probably be the steering column, which consists of quite a few concentric tubes.

"L.B.S.C.'s" Beginners' Corner

A Trailer for "Tich"

QUITE a number of the little *Tich* locomotives have now taken the road ; and so far, they seem to have astonished their builders by the amount of "punch" packed into such a small contraption. This has brought requests for something else ! All sorts and conditions of passenger-carrying cars have been pressed into service for trial runs, from ■ hastily-rigged-up four-wheeler, to heavy three-and-four-seater cars ■ used for carrying outsize loads on club tracks, at fetes, and so on. Our beginner friends now want me to describe how to build a suitable passenger-carrying car which is easy, simple, and cheap to build, to carry one adult or a couple of kiddies, run with the minimum of friction, and (last but not least !) stay on the road when same isn't exactly as level as ■ billiard table, and when the kiddies fidget about, or lean sideways to see the "works" of the engine in action. O.K.—well, let's see what can be done about it.

I have already made certain observations about passenger-carrying cars, in view of actual experience ; so let's do a little simple analysis, and ■ what sort of a car is actually needed. Then we can build accordingly. First of all, unless the line is absolutely rock-rigid, with stout rails continuously supported, a four-wheeled car is taboo ; the weight of an adult is equal to approximately 320 tons—a rider with a little extra avoirdupois can run it to over 400 tons easily—and ■ load equal to a full-length train, *on two axles only*, isn't fair to the engine, and would soon play Old Harry with ■ sleepered road laid with the average small-section rail, same as my own. We therefore decide on two four-wheeled bogies right away.

Ball-bearings

To enable a car to stay on the rails when same are undulating, badly jointed, and out of level in ■ cross-direction, the wheels must be independently sprung, with proper axleboxes working in guides. Stout coil springs, strong enough to carry the load, are better than leaf springs for quick action. Ball-bearings are desirable, so that the car will run with the minimum of rolling friction ; and for reasons of stability, the bearings should be in the proper place, viz. outside the wheels, the ball-bearings being fitted to the axleboxes, and not in the wheels themselves. It may be argued that as one wheel runs faster than the other, on a curve, the wheels with separate bearings are an advantage ; but without going into full explanation—no need to waste space—I can assure you all, from my own experience, that live axles running in ball-bearing axleboxes, outside the wheels, are far more stable and satisfactory than loose wheels on a "dead" axle. The slip of the wheel on the outer rail can be completely eliminated by having one wheel free on the axle, so that the slip takes place there, instead of at the wheel tread ; my own cars are arranged thus.

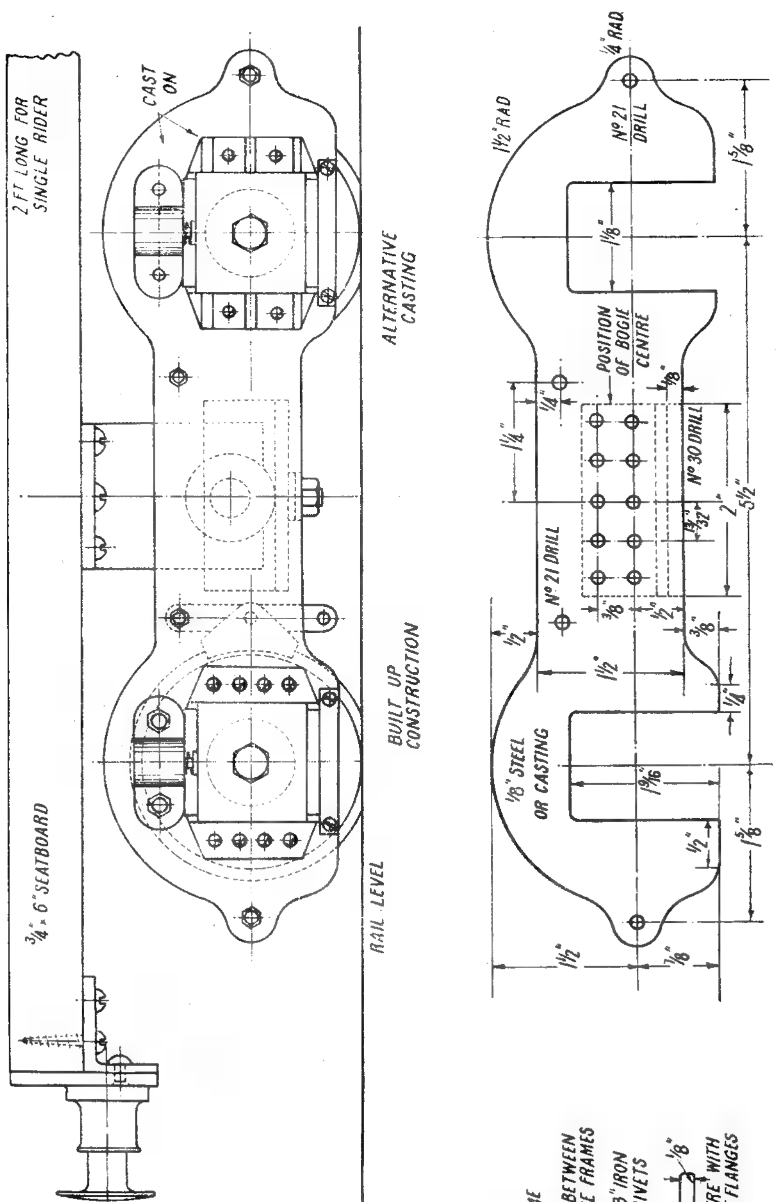
When a bogie car is running on ■ line with moderately sharp curves, and the bogies are fitted with the ordinary bolster, centre-piece and rubbing plate, the turning friction is very considerable, even with only a single adult on the car. The resistance to the turning movement keeps the leading flange pressed hard against the curve of the outer rail, not only putting more strain on the locomotive in overcoming the flange friction, but causing rapid wear of both flange and railhead. Some form of anti-friction device is therefore needed to minimise this. Lastly, as the weight of ■ tiny engine is inadequate for stopping purposes, the car will need an effective hand brake. The above about sums up the principal running requirements ; details, such as couplings, footboards and so on, can be added as desired.

Specification to Fill the Bill

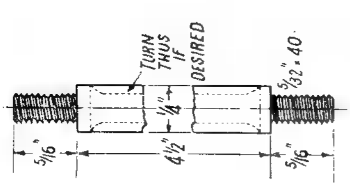
Bearing the above in mind, I got out the specification for a car which not only complies with all the requirements, but is very easily built. The illustrations show the arrangement. The side frames of the bogies may be cast in iron, bronze, or even aluminium, complete with horncheeks and spring pockets, which is going to save a dickens of a lot of time and labour. The centre-piece, and the bolster, may also be castings ; the axleboxes may be cast also. The use of the castings reduces the work of machining and fitting, to the absolute minimum. Contrariwise, as Mary Ann would remark, the whole bag of tricks may be built up from plate, bar, and angle, the joints being either riveted or brazed ; the only castings needed would be the wheels. I will give both methods of construction, all being well. Two bogies per car are needed, one of which is fitted with brake gear.

Each side frame is ■ flat plate, with a lug formed at each end, to take a rod stay. The horncheeks are plain angles ; castings would be ribbed or gusseted. The axleboxes are simple rectangular blocks sliding between the horncheeks, and they cannot fall out when the hornstay, made from plain strip steel, is fitted across the bottom of each opening. Each box is recessed for a ball bearing, and has ■ screw-plug on the outside, for oiling purposes. Spiral springs are fitted in pockets above the axleboxes, and the springs have ■ little pad at the bottom, like ■ flat-headed rivet, which bears on top of the box. The wheels and axles are of the usual type, the wheels being solid disc pattern. One wheel is pressed on to each axle, and one runs free. The two side frames are connected by ■ centre-piece shaped like ■ shallow channel, and by the tie-rods at each end.

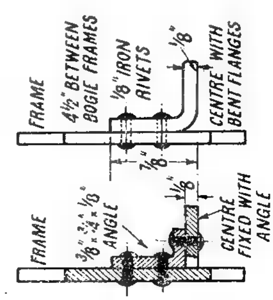
The bolster is also channel-shaped, but has ■



General arrangement and frame plate

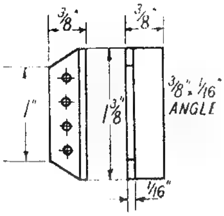


Tie-rod



How to erect frames

flange at each top edge, by which it is screwed to the underside of the seat-board. It carries the usual bogie-pin at the bottom, which works in a bushed hole in the bogie centre-piece ; but the bolster does not come in contact with the centre-piece. A stud is fitted near the bottom



Horncheeks

on each side, and each stud carries a ball bearing, similar to those fitted to the axleboxes. These ball-bearings run on the upper side of the bogie centre, and allow the bogie to swivel absolutely freely, despite the concentration of weight on the car. The brake hangers are attached to the inner side of each frame plate, by studs ; at the bottom, the usual brake beams are fitted, and operated by rods and a compensating link, from a lever at the front end of the seat board. The brake blocks are fibre ; and a very little pressure on the lever, will bring the car smoothly to rest, from full speed, without locking the wheels.

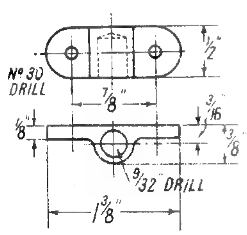
Construction—Cast Bogie Frames

If castings are used—they will be available from our approved advertisers—very little work will be needed to finish them. The rubbing faces of the horncheeks may be finished with a file, if a milling, planing or shaping machine isn't available ; it isn't worth the trouble to set them up in the lathe for end-milling, though they could be held in a machine-vice on the saddle, and the sides of the horncheeks cleaned up with an end-and-face cutter on an arbor between lathe centres. This rig-up was illustrated in the earlier notes on *Tich*, when we were dealing with axleboxes, so our beginner friends can put their acquired knowledge to use. Centre-pop the underside of each spring pocket lug, and drill it 9/32 in., taking care to prevent the drill breaking through the top of the casting ; otherwise you'll have to plug it. The holes should be parallel to the frame and the horn-cheeks ; so if you haven't a drilling machine, hold each frame in a small machine-vice (regular, or improvised from angle, as previously described) against a drill pad on the tailstock barrel, and use the drill in the three-jaw. The only other holes are those in the end lugs, for the tie-rods ; the screw or rivet holes in the middle, for attachment of centre-piece ; and the holes for the brake hanger pins. The illustration gives sizes and position, so no detailing is necessary. If the rest of the casting is fairly smooth, leave it as it is.

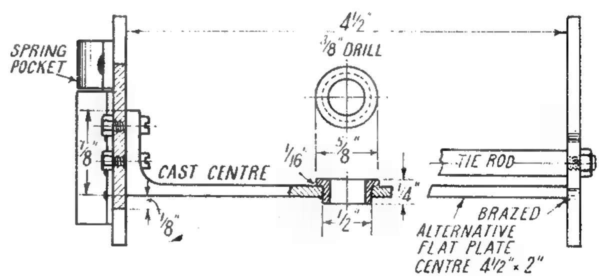
Built-up Bogie Frames

It isn't much more difficult to build up the frames, but it takes a wee bit longer. Four will be needed for each car ; each needs a piece of $\frac{1}{8}$-in. steel plate $9\frac{1}{4}$ in. long and $2\frac{3}{8}$ in. wide. If all four are cut at once, it will need plenty of elbow grease, as $\frac{1}{2}$ in. of steel takes a bit of filing ; the best way would be to do two at a time, using the method described for cutting out the *Tich* frames. When one pair are cut out and drilled, one of them can be used to mark out and drill the second pair ; or better still, work the following wheeze. When you have marked out the first plate, and are going to rivet it temporarily to plate No. 2, for cutting-out purposes, put a bit of thin sheet metal (tin, iron, brass—anything will do) between the plates, sandwich fashion, and rivet up. Then go ahead in the ordinary way. When you part the finished frames, you have a nobby template of them, automatically cut ; and if you want to mark out any more frames, at current or future dates, all you do is to lay the template on the metal, run your scriber around it, and Bob's your uncle. Time is precious nowadays ; I find it so, anyway !

The horncheeks are made from $\frac{3}{8}$ in. × $\frac{1}{16}$ in. angle ; if commercial drawn or extruded angle isn't available, just bend up your own, from $\frac{1}{16}$-in. sheet metal. Steel will do fine. Each piece is $1\frac{3}{8}$ in. long, and bevelled off top and bottom, for sake of appearance. Rivets may be either $\frac{1}{16}$ in. or 3/32 in., whatever you have in stock ; but don't use copper rivets if you have iron or brass ones. Copper rivets have a fancy trick of working loose, quicker than any other kind. Don't forget the trick of jamming a bit of flat bar in the axlebox opening, and setting the horn-cheeks to it before riveting ; use a tool-maker's cramp to hold them in position.



Spring pocket



Cross-sections

The spring pockets can be sawn and filed up from pieces of $\frac{1}{2}$-in. × $\frac{3}{8}$-in. bar, either brass or steel will do, and drilled for the springs ; rivet them in position over the axlebox openings by $\frac{1}{8}$-in. rivets.

How to Erect Bogie Frames

First turn up the tie-rods from $\frac{1}{4}$-in. round steel. If you want to make a posh job of it, the centre part of each can be reduced as shown in dotted lines, but it really isn't worth the trouble. Cut the bits of round steel to length, then turn and screw, with each rod in the three-jaw. If the chuck is a wee bit out of truth, it doesn't matter a bean. Poke one end of each tie-rod through the hole in the lug, and put a nut on ; ordinary commercial nuts will do. Put on the other frame; and when the nuts are tight, you should have a rigid frame assembly, with both frames parallel, all ready to fit the centre-piece. If this is a casting, all you have to do, is to file each side carefully, or mill it if you have the requisites, until it fits nicely between the bogie frames. If you are building up the bogies, the centre-piece can be made in two ways. One is, by cutting out a piece of $\frac{1}{8}$-in. steel plate $6\frac{1}{4}$ in. long and 2 in. wide, and bending up $\frac{7}{8}$ in. at each end, leaving the channel $4\frac{1}{2}$ in. wide, outside measurement. The second is, by cutting out a piece of $\frac{1}{8}$-in. steel plate $4\frac{1}{2}$ in. long and 2 in. wide, and riveting a piece of $\frac{3}{8}$ in. × $\frac{3}{4}$ in. × $\frac{1}{8}$ in. angle, steel or brass, along each shorter edge. Drill a $\frac{1}{2}$-in. hole in the middle, for the bogie pin bush.

The fitting-up job is the same, whether a casting or built-up centre is used. Put the centre between the side frames ; it should be just tight enough to " stay put " if the frames are held up, but not tight enough to spread them. Adjust to the position shown, and put a toolmaker's cramp at each side, to hold them there. Then put the No. 30 drill through the holes in the frames, and carry on right through the angles of the centre-piece. If an aluminium or bronze casting is used, or if the centre is built up, $\frac{1}{8}$-in. iron rivets can be used for fixing permanently ; but if an iron casting is used, the chances are that it will crack under riveting, so in that case it would be advisable to use bolts, or screws and nuts. Ordinary cheesehead screws, put through from inside, and nutted outside, would do very well ; or bolts could be made from bits of $\frac{1}{8}$-in. round steel, screwed both ends and nutted.

There is a third way ; the one that I should adopt if I were building up. Fit the tie-rods, as given above. Cut the centre-piece from $\frac{1}{8}$ in. plate, and carefully fit it between the side frames, at the position shown in the illustration. Tie some iron binding-wire around both frames, at each end of the centre-piece ; or better still, put a home-made cramp over the outside of both frames. Rough cramps to hold jobs while brazing, can be made in a few minutes, from bits of bar and commercial screws ; I have explained how, several times already. Then apply some wet flux to the joints, heat to bright red, and run a fillet of easy-running brazing strip, brass wire, or Sifbronze, along the joint at each side between centre-piece and side frames. If an oxy-acetylene blowpipe is available, the job can be done, with Sifbronze, in two wags of a dog's tail, and is easier than soft-soldering. All that then remains to be done, is to fit a bronze bush to the bogie pin-hole. This is turned from $\frac{5}{8}$-in. round rod. Chuck in three-jaw, and face the end ; turn down $\frac{3}{16}$ in. length to a tight fit in the hole in the centre-piece. Centre, drill down about $\frac{5}{16}$ in. depth with $\frac{3}{8}$-in. drill, part off at 3/32 in. from the shoulder ; reverse in chuck, and face off the head, so that it is about $\frac{1}{16}$ in. thick. Squeeze it into the hole, with the flange upward, as shown. That little lot should keep our friends busy for a week or two ; next stage, axleboxes and springs, wheels and axles.

"Mason Master" Masonry Drills

WE received recently from Messrs. John M. Perkins & Smith Ltd., London Road Works, Braunston, near Rugby, a sample of their tungsten carbide-tipped drills for use in bricks, concrete, tiles and marble.

Made in a range of sizes from 5/32 in. to $\frac{3}{8}$ in. nominal diameter, these drills should be of great value to a number of our readers, especially those who anticipate laying outdoor tracks on concrete. Treated with due care and with intelligent use, they will give excellent service and should amply repay their price in the amount of time and labour they will save.

The " Mason Master " drill

Plastic Rynplugs are useful partners to the tungsten carbide-tipped drills. Hard enough to be hammered into the hole without destroying the ends, they are pliable enough to expand readily in the softest plaster wall without enlarging the hole or pulling out. They have the additional qualities of being moisture proof and free from corrosion, and their insulating qualities make them ideal for the fixing of electrical fittings.

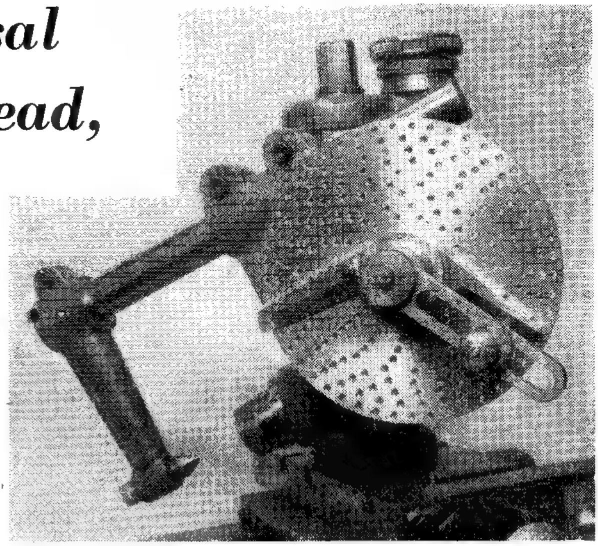
The plastic Rynplug

Sizes from 5/32 in. to 9/32 in. are packed in boxes of 100, and are obtainable in lengths of $\frac{3}{4}$ in., 1 in., $1\frac{1}{4}$ in., $1\frac{1}{2}$ in. and 2 in. The $\frac{3}{8}$ in. size is packed in boxes of 50 and is supplied in 2 in. lengths.

Explanatory leaflets and/or prices may be obtained on application to the manufacturers.

A Universal Dividing Head, PLUS

by A. R. Turpin

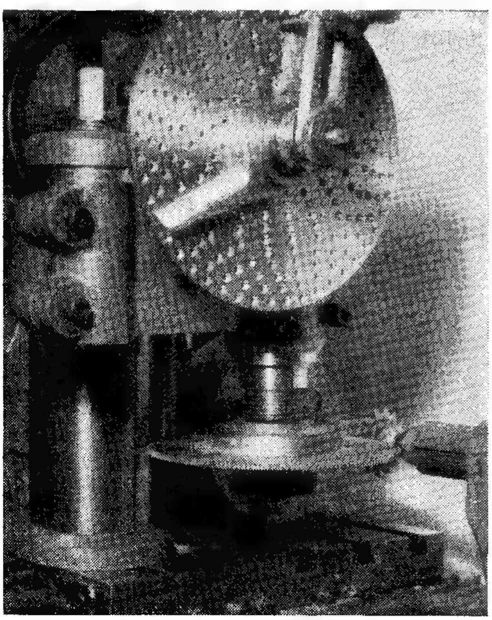


Photograph No. 1. The complete dividing head

I HAVE called this dividing head " universal " and " plus," and would first like to justify these adjectives by enumerating a few of its capabilities. The complete head is shown in photograph No. 1.

First, the head has its own vertica slide, and it can be rotated in two planes through 360 deg. ; secondly, by rotating the pillar through 180 deg., and the head bearing through 90 deg., gear blanks up to 5 in. diameter may be cut, as shown in photograph No. 2.

Thirdly, a back centre is provided so that long and slender work may be divided, see photograph No. 3. Fourthly, by removing one $\frac{5}{16}$ in. Allen screw, the head proper may be removed, and remounted on a simple bracket permanently fixed at the rear of the mandrel, so that division may be carried out on the lathe itself ; this is a more convenient arrangement for such work as the cutting of splines on long shafts, or the division of dials, or feed screw thimbles ; this is shown in photograph No. 4. Fifthly, besides its use as a dividing head, it may also be operated as a circular miller, see photograph No. 5, for the milling of quadrants, angle milling (photograph No. 6), and the cutting of radius grooves in the periphery of pulleys or formers, such as those required for the Kennedy bender, see photograph No. 7. Sixthly, the constructional notes include the making of a simple machine vice that can be fixed with one Allen screw to the vertical slide, and rotated through 360 deg., as is shown in photograph No. 8.



Photograph No. 2. Dividing large diameter blanks

The design of all castings has been simplified so that even those with no wood-working experience should have no difficulty in constructing the patterns, and thus reducing the cost of the necessary materials very considerably. Drawings, and constructional details of these patterns will be given.

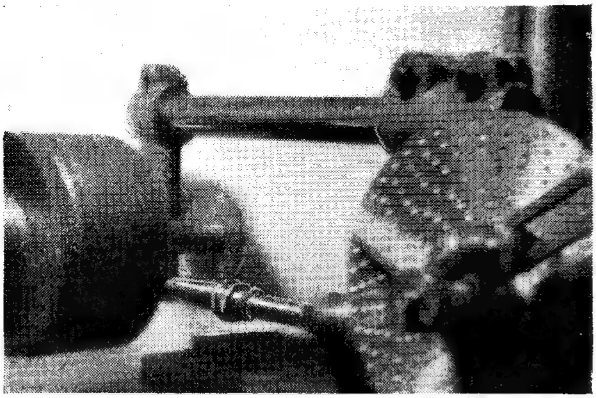
Although I have used a vertical slide during the construction of the prototype, such an accessory is not necessary, and methods of construction without its use will be given. As a matter of fact, the vertical slide of the head itself is brought into use at an early stage when only partly completed.

It may be noted that the drawings do not always coincide with the photographs of the prototype, and this is because certain small modifications suggested themselves during the construction.

Instructions for dividing the division plate without the use of a copy plate will also be given.

A full specification is as follows :—

Referring to the general arrangement drawings Fig. 1 (1), is a cast-iron pillar $2\frac{1}{2}$ in. diameter, and about 7 in. long, a $\frac{3}{16}$ in. key runs its full length, and the bottom end is indexed in 5 deg. divisions. This pillar sits in a recess turned in the baseplate (2), in which it is free to rotate ; this baseplate is accurately positioned by two dowels which fit the boring table slots. The top plate (3) is permanently positioned on the pillar by a



Photograph No. 3. Using the head for cutting equidistant slots in a collet

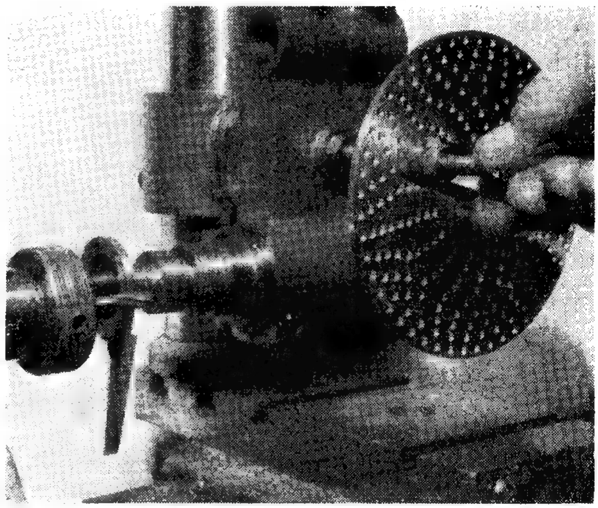
keyway, and carries [redacted] lug for the feed-screw bearing. The pillar, and top and bottom plates, are clamped together to the boring table by a ½ in. diameter bolt, the head of which is machined to fit the boring table slots (4).

The carriage (5), is another casting; it is split longitudinally for adjustment of wear, and clamping when necessary by two $\frac{5}{16}$-in. Allen screws which pass through "cast on" lugs. A keyway is cut longitudinally to prevent rotation, and a circular boss with a turned spigot carries the head bearing, the boss being drilled and tapped $\frac{7}{16}$ in. B.S.F. to take the Allen fixing-screw, the spigot taking all side thrust.

A lug is cast on the side of the carriage to house the feedscrew nut (6), which is held in position by three 6 B.A. cheese-head screws.

The feedscrew (7) is of mild-steel, ½ in. diameter, 10 t.p.i. The feedscrew is fitted with [redacted] wheel which also incorporates [redacted] zero setting micrometer index, (8).

The cast-iron mandrel bearing (9), carries split bearings for the mandrel and back centre support shaft, which can be clamped by tightening Allen screws. The casting is secured to the carriage by a single $\frac{7}{16}$-in. Allen screw, [redacted] recess being turned in the circular base to fit the spigot. The casting can be rotated through 360 deg., and the periphery is indexed in 5 deg. divisions to facilitate angular settings.

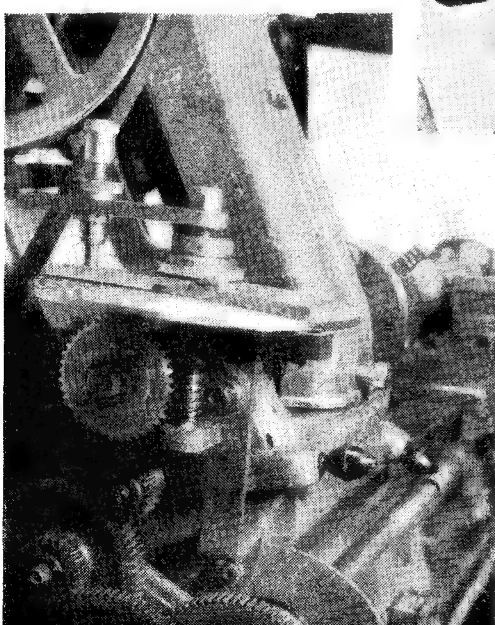


Photograph No. 5. Using the head for semi-circular milling

The mandrel (10), is turned from mild-steel bar, and the nose and bore are replicas of the ML7, so that chucks, collets and centres [redacted] interchangeable; thus work may be turned in the chuck and the whole transferred to the dividing head without disturbing the setting and insuring accurate division.

A bronze worm wheel (11) which is hobbed in the lathe is keyed to the mandrel, the rear end of which is threaded 24 t.p.i. and fitted with a circular nut (12) which supplies a means of adjusting the bearing longitudinally; this nut is locked by [redacted] of [redacted] set-screw bearing on a brass pad.

The worm wheel engages with [redacted] mild-steel worm (13), of Acme thread 6 t.p.i. which is pinned to [redacted] $\frac{5}{16}$ in. silver-steel spindle. This spindle is supported by a cast-iron bearing bracket (14), which is secured to the side of the mandrel



Photograph No. 4. The dividing head mounted at the rear end of the lathe mandrel

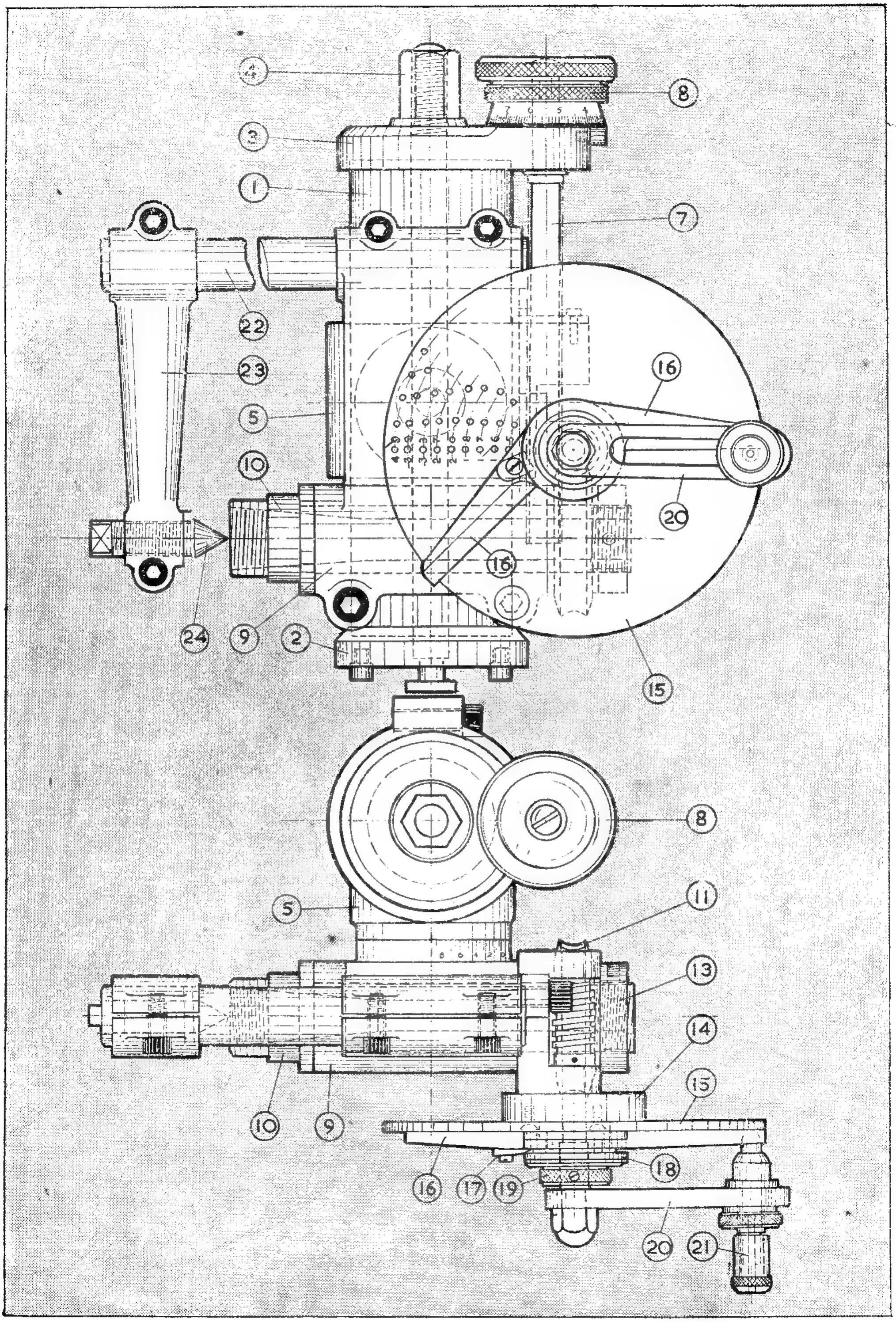
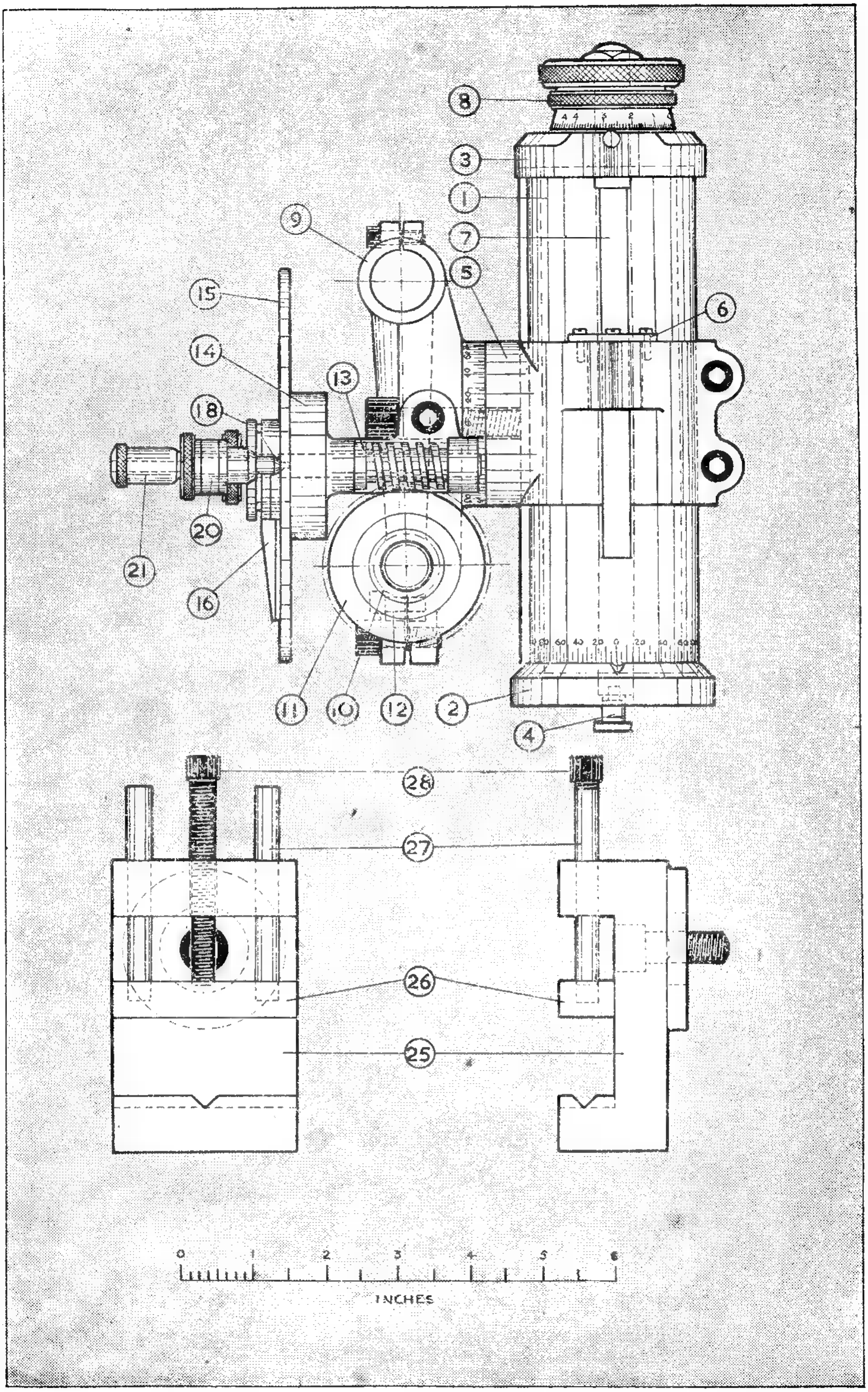
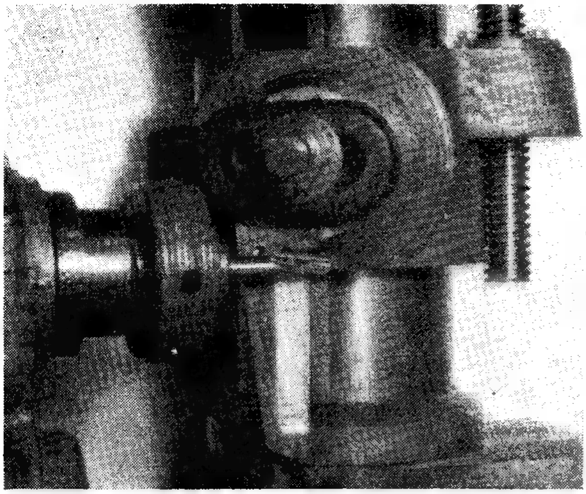


Fig. 1. *General arrangement of divi*

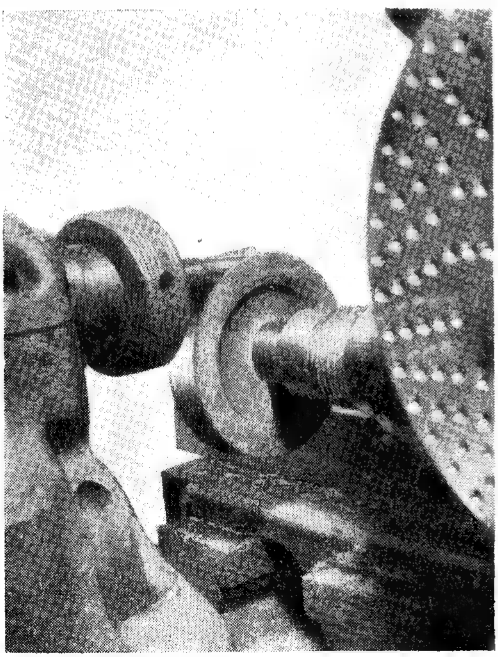


nt of dividing head and machine vice



Photograph No. 6. Using the head to mill the bevel on one of the fingers

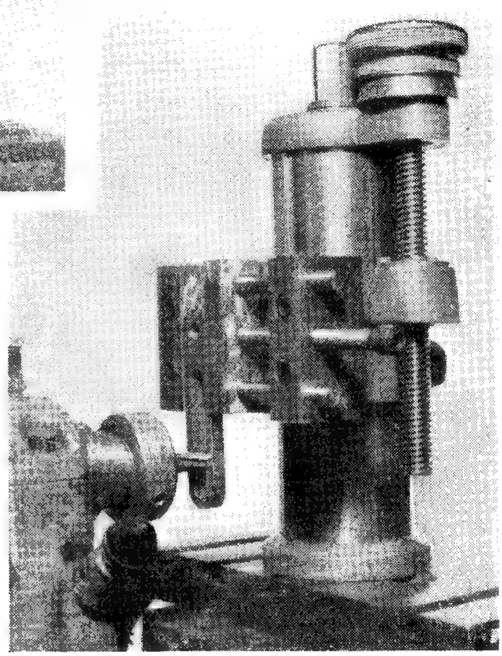
bearing casting by a single $\frac{5}{16}$-in. Allen screw, the fixing hole in the bracket being slightly elongated to enable end play, and wear to be taken up. This bracket has a circular boss cast on with a 1-in. diameter spigot. The division plate (15), is a $5\frac{1}{2}$-in. diameter $\times$ $\frac{1}{8}$ in. brass blank, bored 1-in. diameter through the centre, the spigot on the bearing bracket passing through this hole and the plate secured to the boss by three



Photograph No. 7. Using the head to mill a semi-circular groove in a pulley

6 B.A. countersunk steel screws. The plate is divided 49, 39, 33, 27, 20, 18, 17, 16 and 15 holes which will give the divisions most likely to be required, and the plate being easily detachable, can be replaced by another with further divisions if required.

The indexing fingers are of brass (16), and rotate around the spigot on the spindle bracket, and they can be clamped in angular relation by a small steel clamp (17), mounted on one of the fingers. A brass cap (18), secured to



Photograph No. 8. The pillar slide fitted with a simple machine vice

the top of the spigot by three 6 B.A. countersunk screws, compresses a stout spring washer against the fingers, giving frictional control and prevents vibratory, or accidental movement.

The worm spindle adjacent to this point is enlarged in diameter to $\frac{3}{8}$-in. and screwed 32 t.p.i. and a circular nut (19) bearing on a steel washer gives a means of taking up end play, or adjustment for wear ; this nut is locked by a set-screw bearing on a brass pad.

Above this nut the spindle is reduced in diameter to $\frac{5}{16}$ in. and threaded B.S.F. The detent support bracket (20), is of mild-steel, one end having a $\frac{5}{16}$ in. B.S.F. hole drilled and tapped in it, the bracket is screwed down on to the shoulder on the worm spindle, and locked in position by an acorn nut. This bracket has a $\frac{3}{8}$-in. slot machined in it in which slides the detent (21), and the latter is prevented turning by flats machined on the body of it. The detent is

(*Continued on page* 658)

IN THE WORKSHOP

by "Duplex"

No. 102.—*Making a Twist Drill Grinding Jig

NOW that the form of the drill point has been described and the underlying geometrical requirements have been briefly considered, it is time to give an account of the making of an appliance that will reproduce these essentials in twist- and straight-flute drills ranging from the smallest up to those of $\frac{1}{2}$ in. diameter.

The decision to construct a jig of this kind was made after a large number of requests had been received, apparently because none of the commercial patterns available had, we gathered, proved entirely satisfactory in the hands of amateur workers.

At various times, we have used three commer-

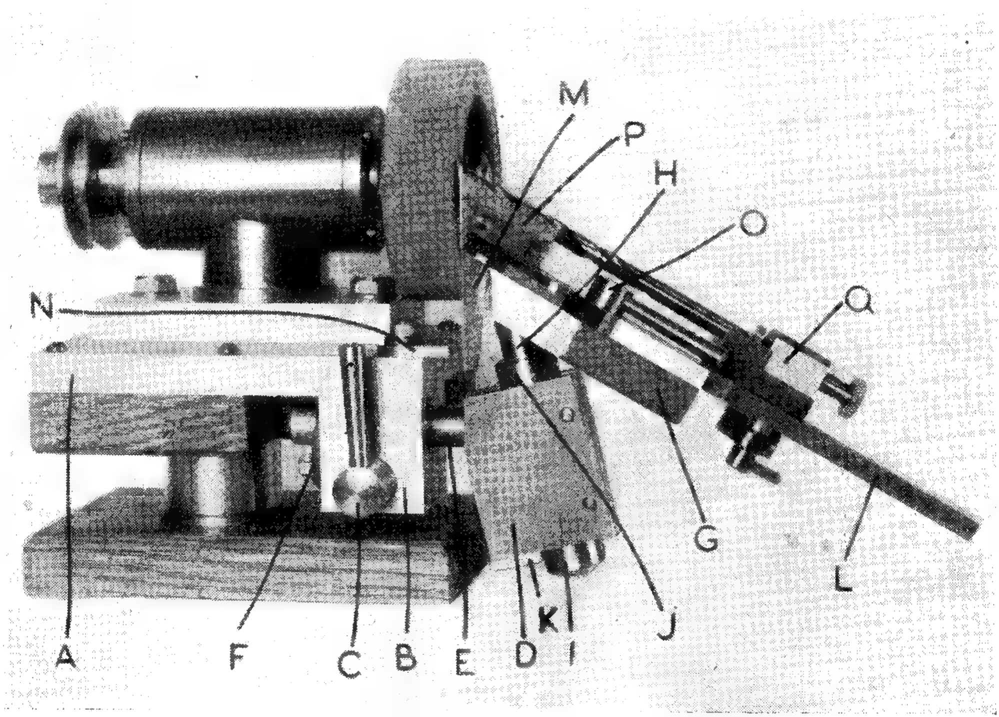


Fig. 12. "A"—Baseplate; "B"—Base bracket; "C"—Base bracket clamp-bolt and lever; "D"—Pivot bracket; "E"—Pivot bracket spindle; "F"—Pivot bracket spindle guide; "G"—Table; "H"—Table pivot; "I"—Table pivot lower collar; "J"—Table pivot upper collar; "K"—Table pivot stop-plate; "L"—Drill slide; "M"—Drill slide stop; "N"—Drill slide stop-plate; "O"—Drill slide clamp-screw; "P"—Drill rest; "Q"—Tailstock

No difficulty will be found in grinding the larger drills, but although the jig is also able to deal with drills down to, say, No. 60, it is by no means easy to hold these very small drills in place against the guide face during the grinding operation; the lower limit of size will, therefore, depend mainly on the dexterity of the operator.

*Continued from page 586, "M.E.," November 1, 1951.

cially produced grinding jigs; one was soon discarded owing to the time occupied in making the necessary setting adjustments; a second has given good service, but the caliper jaws forming the setting gauge cannot be relied on, when, for example, grinding a $\frac{1}{8}$ in. diameter drill, the jaws have to be set to $\frac{1}{4}$ in. to give the correct back-off. To meet this discrepancy, a table was made out experimentally showing the correct caliper jaw setting for each size of drill. Another grinding jig gave insufficient back-off throughout its

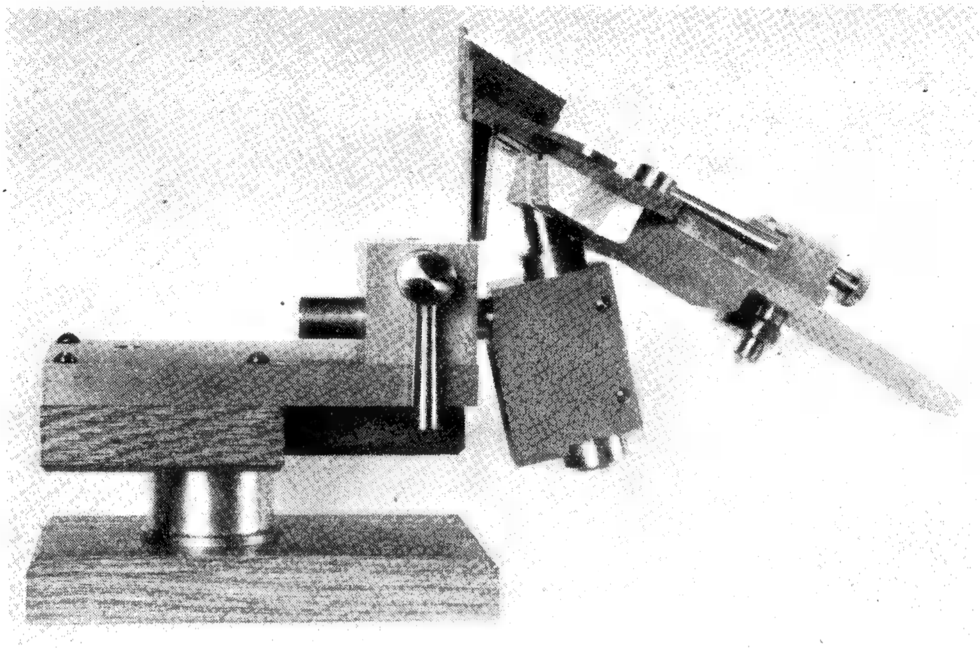


Fig. 13. The base bracket mounted above the baseplate to gain height

range when the caliper setting gauge was used, and again the necessary correction had to be made. Moreover, the jig itself may lack rigidity, or the fit of the main pivot may not be close enough to prevent shake and irregular grinding.

General Design

The finished machine illustrated is mounted on a two-part wooden base for demonstration purposes, and for normal use the steel baseplate is attached either directly to the bench, or by means of a single wooden base, so as to allow the drill slide to overhang the edge of the bench. As will be seen, a special grinding head, which will be described later, is secured to the common baseplate, but if instead the ordinary type of bench grinding head is used, the base-bracket carrying the jig is then mounted on top of the base, as illustrated in Fig. 13.

The increase of height thus obtained will enable the drill-point to make contact with the grinding wheel at the proper level.

It is, of course, possible to make the contrivance a self-contained unit by mounting a $\frac{1}{4}$-h.p. electric motor on a common base of larger size, and arranging the drive by means of a short, V-belt.

With regard to the actual construction, it will be clear that the use of a shaping machine will provide the most convenient means of forming the numerous flat and angular surfaces that have to be accurately machined. The longest machined surface is 7 in. in length, but if, in the larger sizes, stub drills are used instead of the ordinary kind, the length of the drill slide can be reduced from 7 in. to 5 in. and it will still be possible to grind a $\frac{1}{2}$ in. diameter drill. Where this modification is made, it may be found possible to do the machining in the lathe by a process of milling or fly-cutting, and at any rate a small, hand-operated shaping machine should suffice.

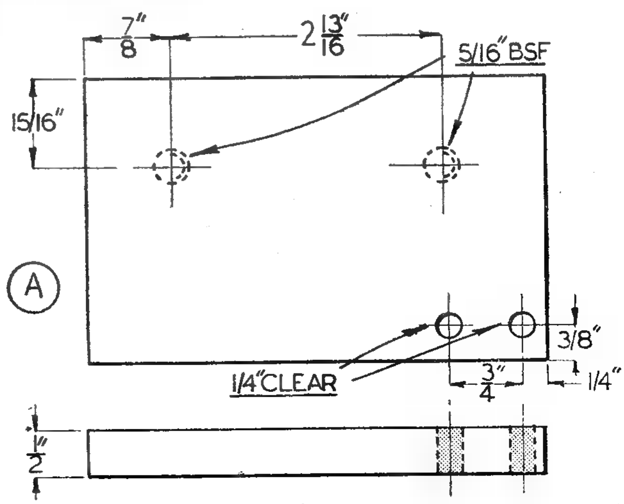


Fig. 14

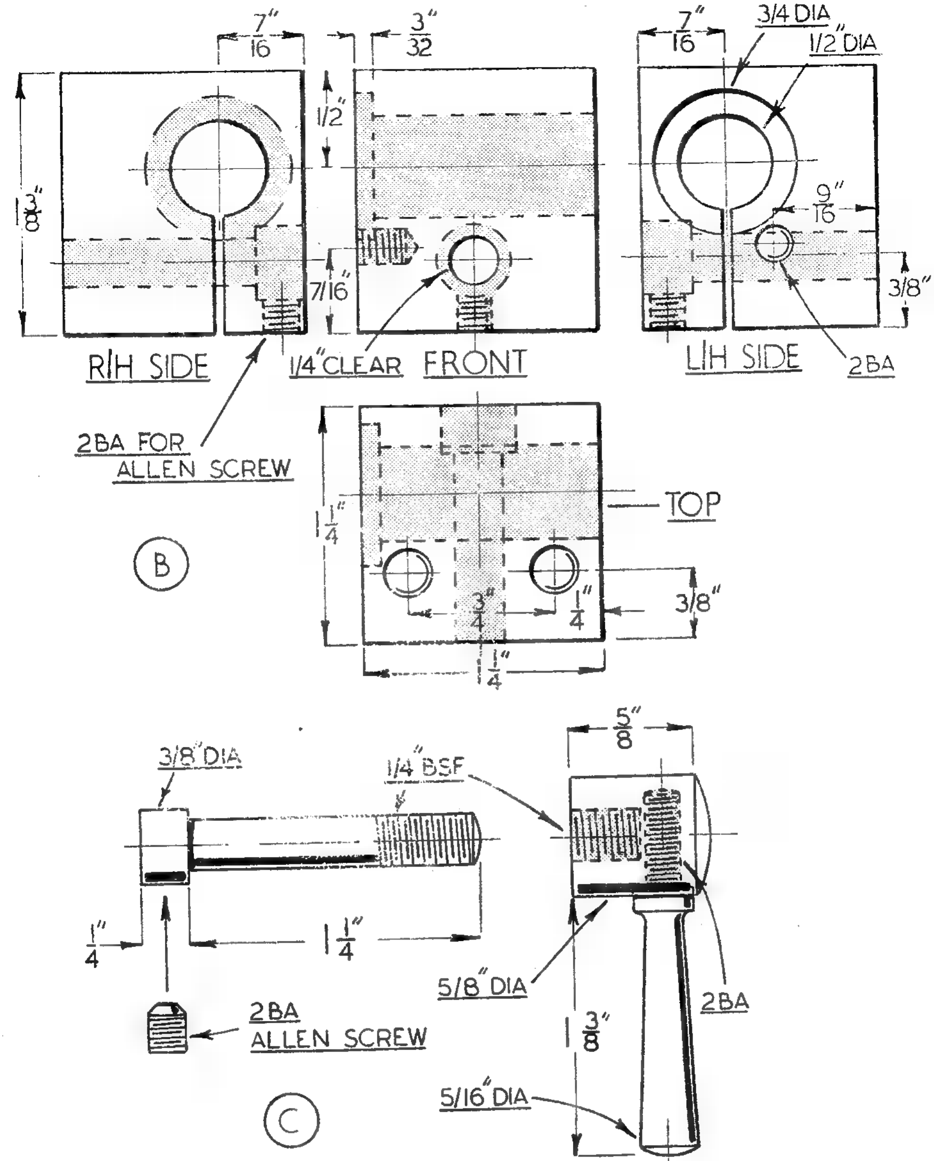


Fig. 15

A machine hacksaw will save much time and labour when cutting up the material, and, in this connection, the small bench hacksaw recently described was used for nearly all this work, as well as for the slitting operations on the two pivot brackets.

Constructional Work

A start can be made with the baseplate (*A*) and the machine then built upwards on this. Whether a steel or a cast-iron baseplate is used, all surfaces should first be filed or machined flat. The $\frac{1}{4}$-in. clearing holes for the two screws attaching the base-bracket are next marked-out and drilled, but any counter-drilling for the screw heads is best left until later, as this will depend on the type of screws used and whether the base-bracket is mounted above or below the baseplate. If the self-contained grinding head illustrated is going to be fitted, the holes for its base-screws can be drilled and tapped at this stage; the position of these screws is shown in broken lines in the working drawing. For fixing the baseplate to a wooden base, three wood-screws can

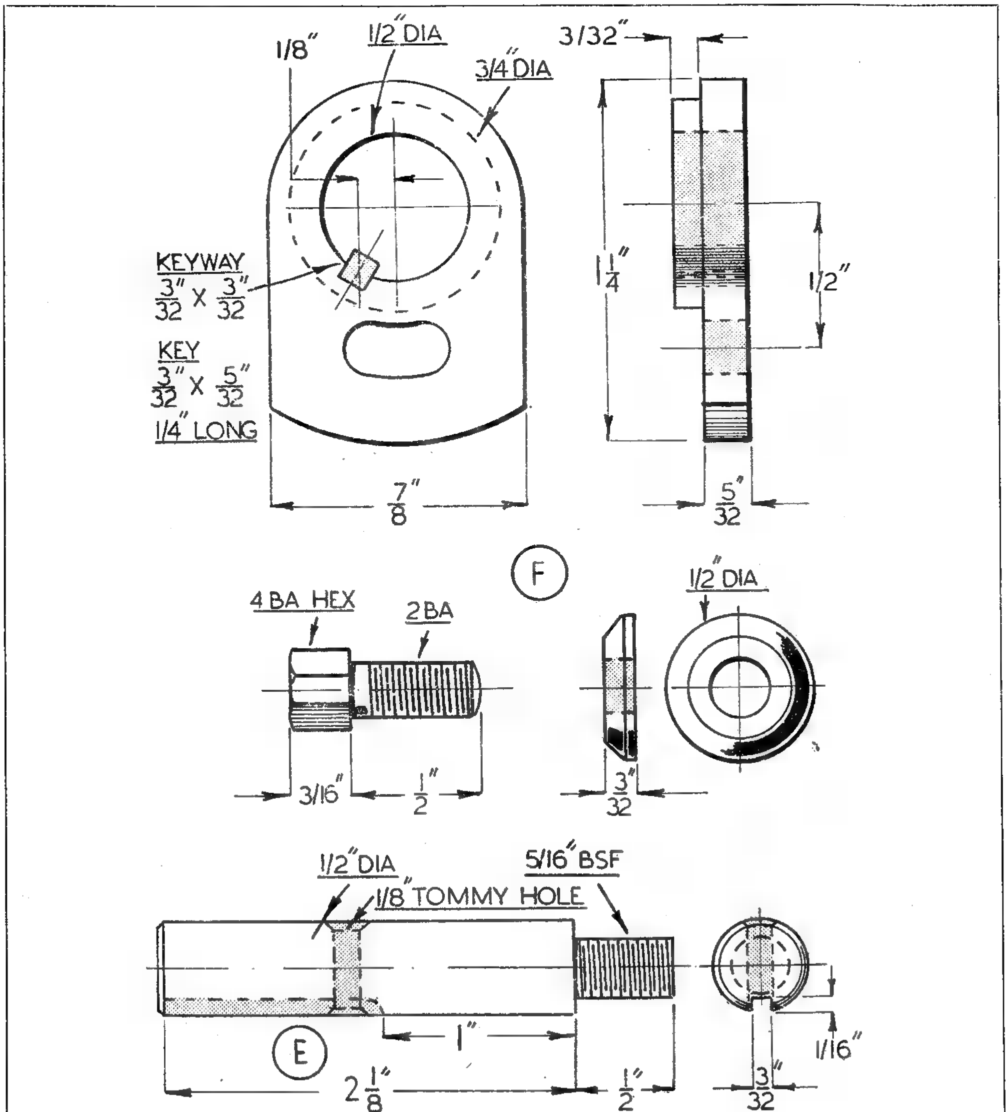


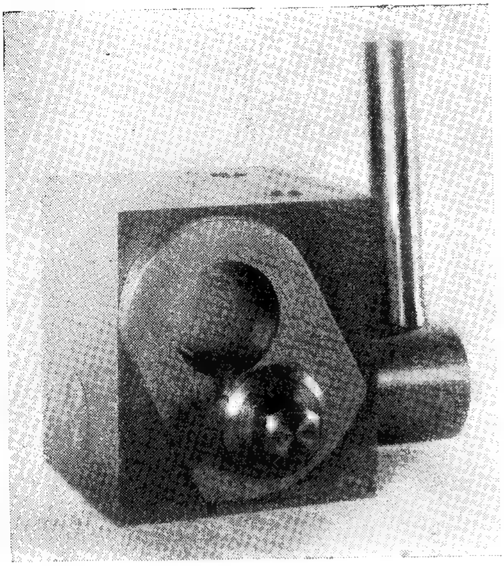
Fig. 16

be inserted as shown in Fig. 12 and a fourth is put in mid-way between the two holes for the grinding head attachment screws, or in the position illustrated in Fig. 13.

The Base-Bracket—B

This part is machined either from a piece of mild-steel bar or from an iron casting. When fitted below the baseplate, the bracket is attached by means of an Allen screw and [redacted] hexagon-headed screw that also serves to secure the small stop-plate (*N*); but if the bracket is mounted on top, two Allen screws are then inserted from below.

After the bore for the spindle (*E*) has been drilled and bored, it is advisable to finish the interior by lapping, so that the spindle will slide freely when the drill is being moved up to the grinding wheel. As will be seen, the clamping bolt is formed with a long head fitting into [redacted] recess machined in the bracket; in addition, a set-screw is fitted to secure the clamp-bolt after it has been rotated to bring the lever of the clamp-nut into [redacted] convenient position for handling. The recess formed at the end of the spindle bore is for locating the spindle guide (*F*), but if the base-bracket is mounted above the baseplate, [redacted] illustrated in Fig. 13, this recess must then be machined at the opposite end of the bore and not [redacted] represented in the drawing.



Slitting

The final operation on the base-bracket is to cut the slit that allows the clamp-bolt to close the bore on the spindle, and so give the attachment ■ rigid mounting when grinding the drill.

This slitting, can, of course, be done with ■ hand hacksaw, but ■ neater job will probably result if the work is done with a circular milling saw mounted in the lathe. However, this is a rather heavy cut for a small circular saw, and there is always the danger of damaging the teeth where the work surface is large and the cutting pressure has, in consequence, to be increased.

In actual practice, the base-bracket was slit in the small bench hacksaw machine recently described in these articles.

The set-up illustrated in Fig. 18 shows, as it happens, the slitting operation being carried out on the pivot-bracket (*D*) which, with its spindle, will be the next part to be made.

(To be continued)

Left—Fig. 17. Showing the spindle guide—" F "—attached to the base bracket

Below—Fig. 18. Slitting the pivot bracket—" D "—in the bench hacksaw machine

The Spindle—E

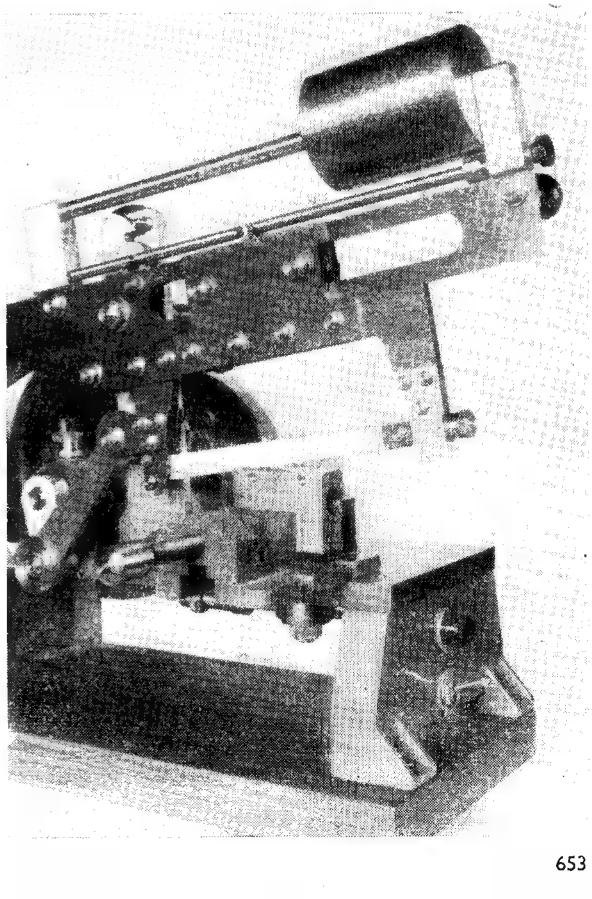
The next step should be to make and fit the spindle (*E*) to the base-bracket. Here, again, this part should be finished by lapping to ensure ■ smooth, sliding fit. The short keyway can quite easily be milled or fly-cut in the lathe, and ■ tommy-hole is afterwards drilled across the shaft and then deeply countersunk at either end; the use of a tommy will enable the spindle to be screwed firmly home without danger of damaging the bearing surface.

The spindle guide (*F*) can next be machined by mounting a short length of flat mild-steel in the four-jaw chuck. After the bore has been finished with a boring tool and the register turned to fit in the recess in the base-bracket, the keyway is cut on the diameter by using ■ small boring bar, carrying a square-ended cutter; the lathe saddle is then racked to and fro until, by taking light cuts, the keyway is formed to the full depth.

The small key is made a light press fit in the guide-plate, but it must be made to slide smoothly in the spindle keyway.

When in position, the key cannot move endways, for it abuts at one end against the body of the bracket, and the other end is clamped by means of the fixing screw and washer.

The slot is formed in the guide plate to allow the spindle to be rotated on its long axis, in order to adjust the position of the drill in relation to the face of the grinding wheel.



PETROL ENGINE TOPICS

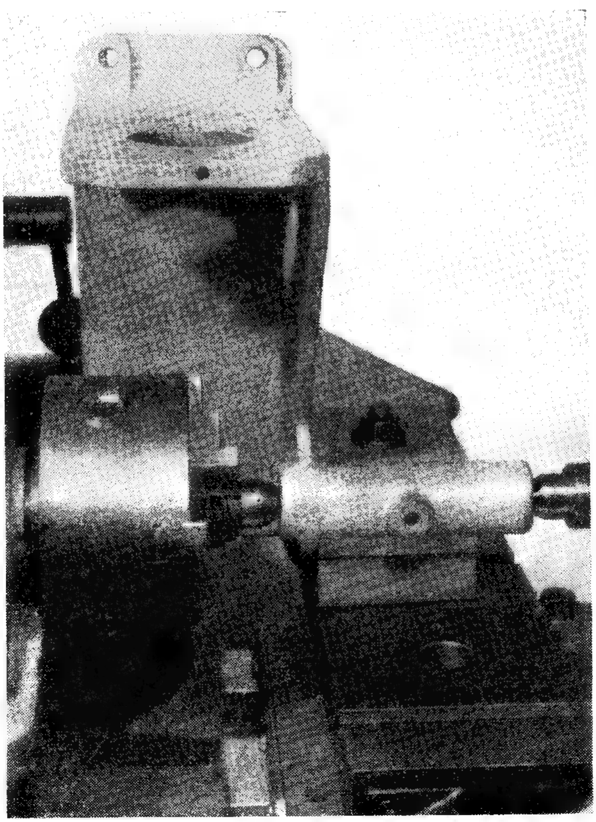
*"New Engines for Old!"

How an Ancient Gas Engine was Improved, Modernised, and Given a New Lease of Life

by Edgar T. Westbury

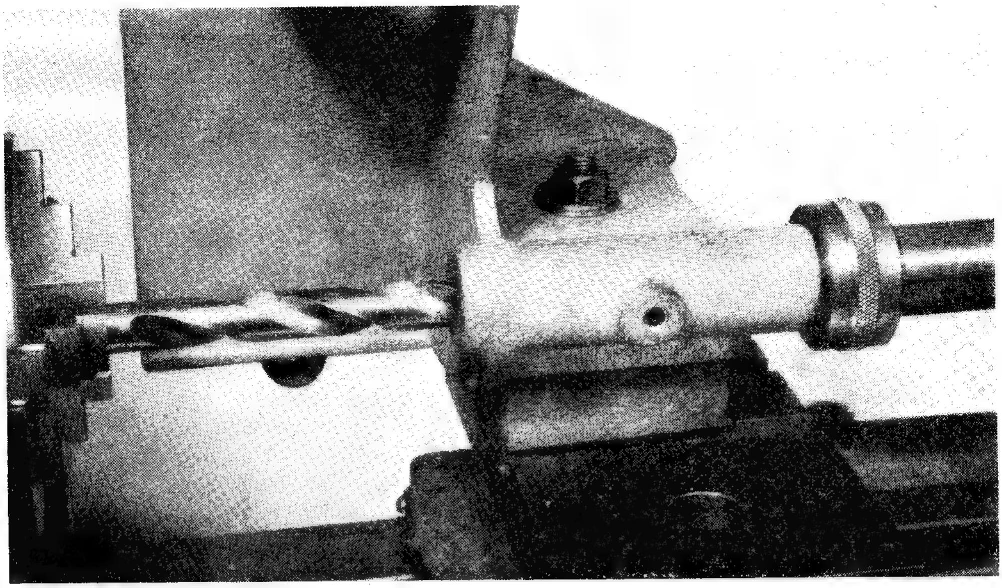
WHILE the exact processes involved in the reconstruction of this particular engine may not be directly applicable in other cases, it is hoped and believed that a description of them will be helpful to many readers who may be faced with somewhat similar problems in rebuilding any type of engine or machine. However, even if we go no further than dealing with horizontal stationary gas and petrol engines, there must be quite a few of these in existence which are worth more or less extensive renovation; and in the case of this particular design—a rather distinctive, if undistinguished one—the fact that the castings were featured for several years in displayed advertisements in THE MODEL ENGINEER leads one to believe that many model engineers, must at least have made some attempt at its construction, and that the relics of such attempts may still be found in the dim recesses of workshop cupboards and scrap boxes. That being so, no apology should be necessary for dealing in detail with the methods employed with this particular job.

Having completed the dismantling of the engine, and the examination of its components, it was decided to make a start by rectifying the sins of omission on the part of the original constructor, in respect of the machining of the main castings. It has already been explained that beyond the application of a file, very little had been done to true up essential reference surfaces on the body casting; and on making a check-up of these surfaces, it was found that, what with necessary draft allowance on the patterns, and other inaccuracies, no two of them were square with each other. The question arose, therefore, what could be taken as a datum line to begin machining operations. In the normal course of events, one might normally expect to be able to work from the base line, but apart from the fact that the under surface was a good deal out of truth, it could not have been used as a mounting surface, in view of the fact that all the machining had to be done on the Myford ML7 lathe. Had a lathe of, say, 6 in. centres been available, it might have been possible to mount the casting in the orthodox manner on the cross-slide, but limitations in the centre height made it necessary to adopt methods which were, to say the least, somewhat removed from "established practice." The essential point,

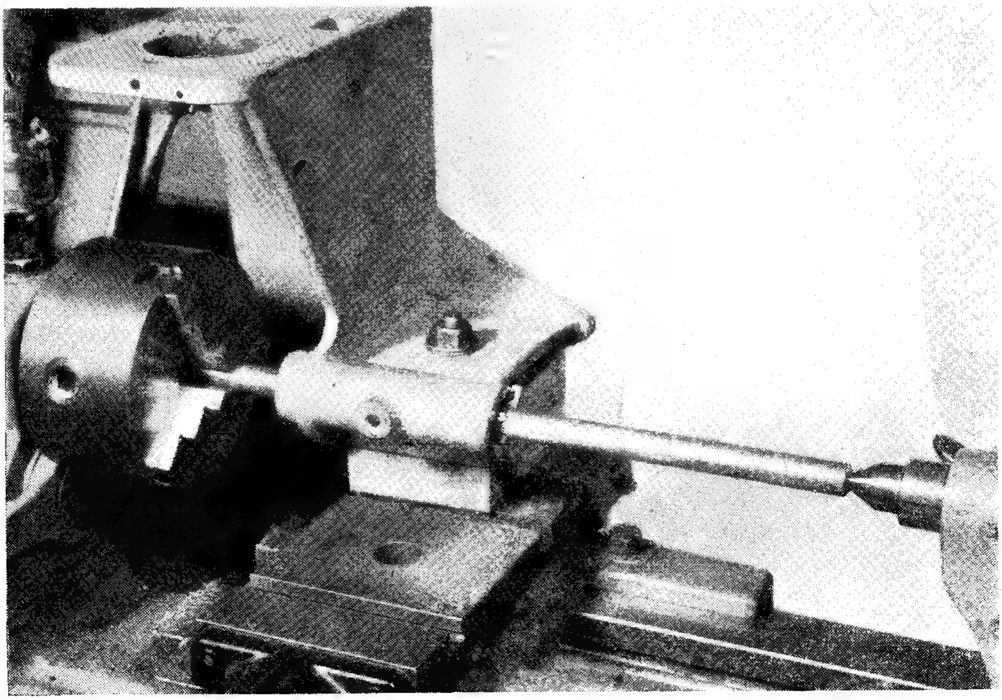


Body casting set up on cross-slide for boring main bearing; showing alignment check between lathe centres

*Continued from page 574, "M.E.," November 1, 1951.



The preliminary drilling-out operation on main bearing housing

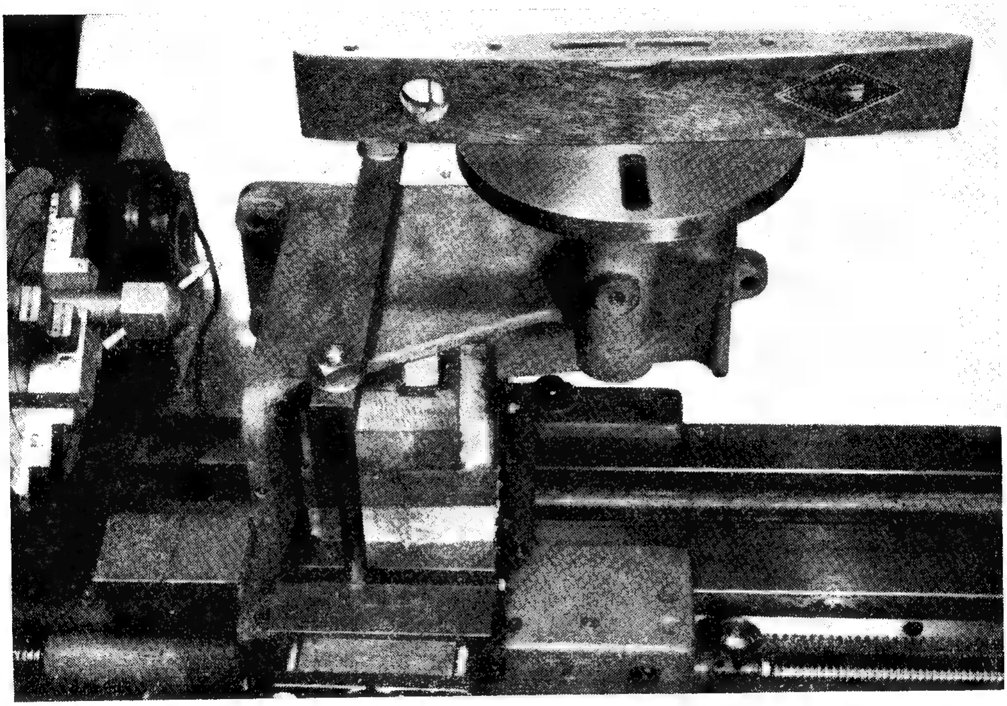


After boring with the cutter-bar, a facing tool was used to true up the end faces of the housing

however, is that they produced the desired results.

Setting-Up

As the hole through the main bearing housing was located reasonably truly in the centre of the latter, and had been machined after a fashion, it was decided to take this as the reference line for machining operations. The only way in which the casting could be mounted on the cross-slide for opening out and finishing the bore of this hole was by setting the base line vertical, and packing the web of the housing to bring the centre-line of the housing level at each end with the lathe centres. This involved a good deal of trial and error work, or as my Irish charge-hand would say, "finaigling," and hardwood packing cut from old printer's block mounts came in very useful. It was by no means a straightforward job, as the web, which formed the only practicable mounting surface, was rough cast, with the usual taper on the sides for draft, and the packing had to be pared away to correspond; moreover, allowance had to be made for the compression of the wood in clamping down.



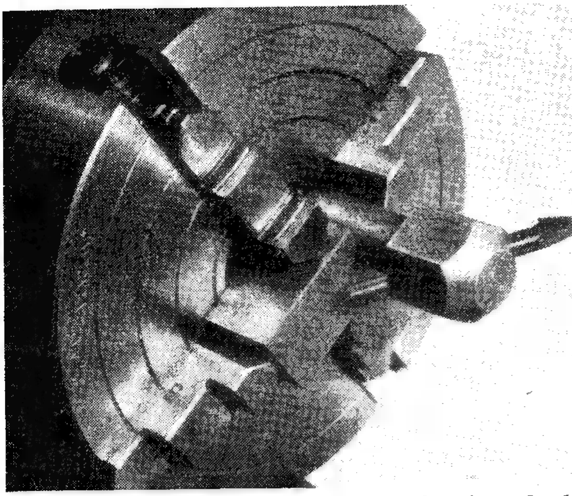
Using a spirit level to check the accuracy of the setting for machining vertical face

Packings

It may be remarked here that hardwood packing is best avoided for duties where exact location is necessary, because of its compressibility, but there are occasions where it is far better than metal packing, especially when clamping on rough surfaces. In the latter case it has the advantage of distributing the pressure much more evenly, and thus improving the grip without undue stress on the component. For very rough or uneven surfaces, softwood packing may be better still in this respect, but almost useless for precise location; its use, therefore, should be confined to "top packing" (between the work and clamps), not between the work and the machine table or faceplate.

Clamping

As it was rather awkward to arrange suitable clamps for holding the casting in this rather precarious position, and it was considered undesirable to put undue pressure on the main bearing housing, a hole was drilled through the web of the casting to take a single $\frac{3}{8}$-in. tee-bolt, and this enabled it to be secured firmly enough for the operations required. Here it may be remarked that machinists often assume that clamping-bolts should be tightened up to the limit of one's physical strength, but this is neither necessary nor desirable; in many cases it may result in distortion of the work-piece, and on light machines, it further involves the risk of tearing the bolt out of the tee-slot. In the Navy they have an expression "taking the strain," which means estimating to a nicety the required amount of tension required on a rope, turnbuckle or bolt, and not "tearing things up" by the use of excessive brute force; the same sort of judgment is necessary in the machine shop.



Fly-cutter eccentrically mounted in four-jaw chuck

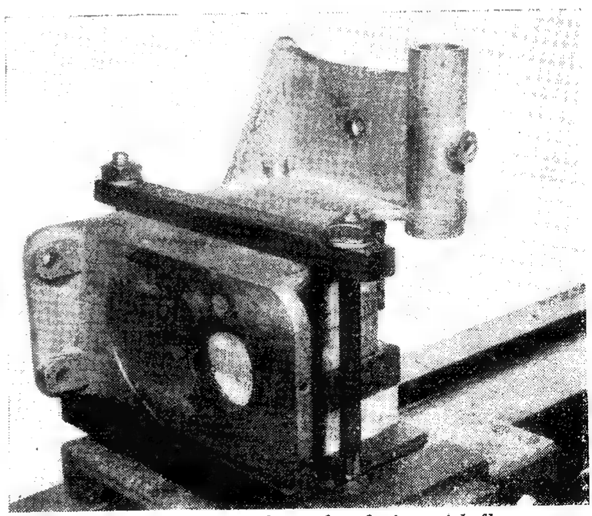
To ensure accuracy in setting-up, centred plugs were fitted in the ends of the bearing bore, and checked with a surface gauge both vertically and horizontally. In the latter case, use was made of the two dowel pins fitted to the base of the Moore & Wright universal surface gauge; these were pushed through so as to locate against the front edge of the lathe bed, to enable the horizontal location to be taken from this point. After final setting and clamping down, the centring plugs were removed and the alignment checked by entering the head and tail centres in the two ends of the hole, and verifying that they made contact all round without forcing. This is shown in the photograph; it may be noted that one of the centres is carried in the 3-jaw chuck, which was necessary because the projecting base of the casting would not allow it to be brought up to the mandrel nose; the true running of the centre in the chuck was, however, verified before attempting to use it to gauge alignment.

All this setting-up business may appear very tedious, and it is ■ fact that such operations often take very much longer than actual machining; but it is a very necessary preliminary to enable work to be machined accurately, and I would emphasise the fact that no one is entitled to call himself a machinist unless he can set a job up truly, and is prepared to take infinite pains, if need be, to ensure that it is right before he applies a cutting tool to the work.

Boring the Main Bearing Housing

It was decided to bore out the hole to $\frac{3}{4}$ in. diameter, so as to allow of fitting ■ $\frac{5}{8}$-in. shaft, with bearing bushes having a wall thickness of $\frac{1}{16}$ in. Any smaller bore would have been difficult to machine accurately, and any larger bore would have weakened the housing, which, of course, is required to withstand the maximum explosion pressure exerted on the piston. It would have been quite practicable and sound to have dispensed with bushes for this bearing, and the original arrangement of running the shaft direct in the cast-iron housing is by no means unsuitable, even for fairly high duty; but the advantage of using bushes is that they can be renewed easily if they become worn, and by inserting one at each end, the shaft is supported at the points of highest stress, leaving ■ space in the centre for a reserve oil reservoir. With an overhung crankshaft, the centre part of the bearing serves no useful purpose, and practically all wear of bearing and shaft alike takes place near the two ends.

The bore of the housing was first opened up with twist drills (flat or straight-fluted drills would probably have been better, had they been available) to $\frac{5}{8}$ in. diameter, to admit ■ boring bar of $\frac{1}{2}$ in. diameter, which was used for final sizing of the bore. A slow speed was desirable both for drilling and boring, so the lathe was run on top back-gear speed, and as will be seen from the photograph, the tailstock drill pad was used to balance end thrust in the drilling operation, and prevent any tendency of the work to slew round. As the original hole was not quite axially true, and the centre was cored, the drill was deflected to some extent, and ■ slight wobble was apparent, but by proceeding cautiously and not forcing the pace, serious deviation was avoided. The boring bar was necessarily on the slender side, and this wobble tended to continue during the boring cuts as a result, but the same cautious methods in applying the feed enabled it to be eliminated, and in finishing the bore, several passes were made without putting on extra feed to eliminate all spring, the speed being



The vertical bolting surface after facing with fly-cutter

increased to direct drive on the bottom pulley.

The use of a rotating cutter bar, well supported at both ends, is recommended in all cases where axial and parallel accuracy is necessary, and it is often easier to mount a large component on the cross-slide than on the faceplate or in the chuck. When only a small diameter bar can be employed, it can be supported better by holding one end in the chuck than by running it between centres; but in all cases it is desirable to use the maximum possible size of bar, to ensure rigidity. Boring to exact dimensions with a rotating cutter demands very careful adjustment of the radial setting, but in many cases, such as this, it is not necessary to work to fine limits, as the bushes or other mating parts can be adjusted in size to suit.

After boring, the end faces of the hole were trued up, using a side cutter in the boring bar, as shown in the next photograph. The cutter was ground in such a way that it could be used to face both ends of the housing. Information on the making and application of boring bars and cutters has recently been given in THE MODEL ENGINEER by "Duplex," so there is no need to go into details on this simple matter.

Rear Bolting Face

The vertical surface of the casting, to which the cylinder is bolted, now had to be tackled, and this was still more awkward to set up, especially in respect of accuracy in relation to the bearing housing. It is, of course, highly essential that the axis of the cylinder should be truly at right-angles to that of the crankshaft, if the engine is to run efficiently with normal bearing clearances, and this entails not only that the bolting flange of the cylinder should be square with its axis, but also that the surface to which it is attached should be parallel with the bearing axis.

It was decided to machine this surface with a single-point fly cutter, the casting being turned on its side and clamped over the side web by two tee-bolts and a strap, with hardwood packing under the web to support it at about the correct height, though this dimension was not critical, as no concentric location was involved. The problem of ensuring that the surface was parallel with the bearing axis was, however, a rather difficult one, and various methods, such as "sighting" a mandrel fitted in the bore of the bearing, were tried and discarded as not providing positive accuracy. Eventually a satisfactory result was attained by pressing into service the table of the "M.E." drilling machine, which was fitted to a short spigot turned to fit accurately in the bearing, checked for true running on the face, and inserted in the bore. It was then possible to use a spirit level to check the parallelism of the table, and hence the squareness of the bearing axis, with the lathe bed. This assumed that the latter also was level, a fact very easily verified; incidentally, it gives a very good reason why, in installing a lathe, the bed should be carefully levelled both ways, as this will often help in setting-up work. Even a cheap spirit level is quite a sensitive instrument, and its accuracy is very easily checked by turning end for end.

Using the Simple Fly-cutter

For the machining operation, the simple fly-cutter holder which was described in THE MODEL ENGINEER many years ago, and has featured in many similar jobs dealt with in my articles, was employed, but the usual procedure of holding it in the 3-jaw chuck was not applicable, in this case, as the required radial reach could not be obtained without extending the cutter too far for reasonable rigidity. To avoid the necessity for making a new holder, the device was, therefore, held eccentrically in the 4-jaw chuck, but as the jaws could not be brought to bear on it sideways, a packing block with a vee-notch was used to locate it, as shown. This enabled the face-milling operation to be carried out without incident, and the result can be seen in the last photograph in this series

(*To be continued*

A Universal Dividing Head, PLUS

(*Continued from page* 648)

clamped in the required position by a circular milled nut, and held in its division hole by a compression spring: the detent is lifted by pulling up the brass cap screwed to the end of the detent spindle.

A $\frac{7}{8}$-in. diameter mild-steel shaft (22), supports the back centre bracket (23) in the small end of which is screwed the hardened back centre (24). Both ends of the bracket are split and can be clamped by screws.

The machine vice consists of a "Meehanite" casting (25), in the base of which is bored a recess to take the spigot on the carriage casting, and it is secured to this by a single $\frac{7}{16}$-in. Allen screw.

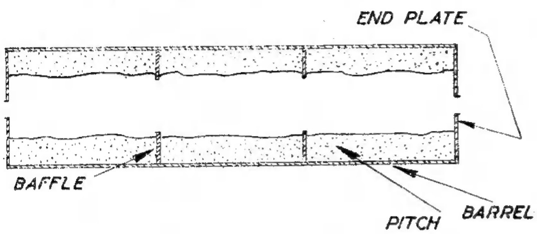
The movable jaw of the vice (26) is of mild-steel, and two $\frac{5}{16}$-in. diameter silver-steel guides ensure parallelism; the jaws are clamped by a single $\frac{5}{16}$-in. diameter Allen screw (29).

(*To be continued*)

PRACTICAL LETTERS

Musical Boxes

DEAR SIR,—As a result of reading your appeal for information concerning the repinning of musical boxes, I gladly offer what little information I can give on the subject. I regret, however, that I am unable to write from personal experience, as my information is second-hand, having been given to me some years ago by a clockmaker, whose German father once undertook this extremely tedious task.



Pinning musical boxes—the barrel section

The wire, similar to piano wire, was obtained from Switzerland in short, straightened lengths, machined to the profile shown in the rough sketch, each pin being snipped off as required.

The end plate of the drum, which is sprung into position, is removed, and the pitch which lines the interior is melted out. This pitch prevents resonance in the drum and helps to anchor the tails of the pins.

The pins are then loosened by immersing the drum in an acid, the nature of which escapes me, but obviously it must react quicker on the steel than the brass. After washing and drying, the pins are either withdrawn or punched through.

After cleaning up, all is ready for the tedious job of repinning, and there appears to be nothing for it but to tap each one home individually. In the heyday of the musical box industry, this was a job often put out to workers to take home where the family lent a willing hand.

Naturally, the pins are put in taper first, and the parallel part is a driving fit in the drum.

When this is finished, the interior is repitched, and then the drum is set up for "topping off," that is grinding off the tops of the pins while the drum is rotating, so that they are all the same correct height.

Enlarged view of pinning wire

I am afraid I have no idea whether pinning wire is still obtainable or where enquiries should be sent. The making of the pins alone would be quite a task. I have estimated that there are well over 2,000 pins in the one I possess.

One further note about the causes of damage. Boxes often got into the hands of children, and one dodge was to lay something straight along the comb teeth thus preventing their lifting, and the pins were bent over or broken. This, of course, apart from the "fun" of just breaking individual pins off.

Sometimes the "fly" became damaged and the drum sped round out of control, which usually cleared all the pins off in double quick time.

My informant also told me that a spring breaking during playing would cause considerable damage.

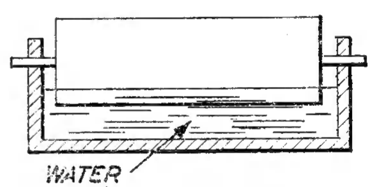
I submit the foregoing brief description in the hope that it may be of assistance should no one with personal experience come forward with more precise details.

Yours faithfully,

Bromley. DOUGLAS HUGHES.

DEAR SIR,—I was interested to read your appeal for information on musical boxes. It may be within your knowledge that I have a carefully collected selection of musical boxes, representing many years of ardent investigation. It is possible that the little information I can give may be of assistance and is backed up by help from a very dear friend of mine, who, in his youth, has repaired cylinders.

The cylinder was marked out on a machine, something like a typewriter, which indented the



surface with centre-pop marks. Then holes were drilled to a push-fit size to steel wire which had been drawn through a draw-plate and thereby work-hardened. Sometimes these wires were sold as "sticks" of cast-steel wire shaped as shown in sketch, hardened and tempered. You drove these sticks into the holes and snapped each one off at the recess. The wires were driven right through the thickness of the walls of the cylinder and left projecting into the inside by about $\frac{3}{16}$ in. to $\frac{1}{4}$ in. Powdered wax was introduced inside the cylinder, the end plates with spindle were mounted, the whole lot was set up in a lathe and a spirit lamp placed underneath. The lathe was run very fast and the flame was played from end to end. The wax melted and was thrown by centrifugal force to the outside of the barrel bore. The flame was removed and the speed of the lathe gradually reduced as the wax cooled. This wax plays a highly important part. It holds the pins in the cylinder and is also responsible for most of the wonderful resonance of a high-class box. I do

not know the composition of the wax. It was a secret and much store was placed on it. Now it will be obvious that to remove the pins, the reverse procedure must take place. The wax has to be melted first, as it is *impossible* to drive the pins out against the holding power of the wax. To melt the wax, you journal the cylinder in two slots cut in the ends of a shallow tray, filled with water kept hot (see sketch).

Rotate the cylinder until the wax melts and frees the pins. Bent pins are straightened with pliers and the pins are held very tightly with the jaws while a gentle straightening force is applied. In practically every case they will break off while being straightened. Now each broken pin *must* be filed off level and flush with the cylinder. A silver-steel punch is next turned a few thou. smaller in diameter than the pin and the pin can be driven out into the inside of the cylinder with care. If you make a mistake and do not hit the pin squarely, it is best to forget it at once, as the brass of the cylinder is so soft that the surface gets burred and nothing will get the pin out. After new pins have been inserted, the process of "spinning" the wax as mentioned before is gone through and the cylinder is ready. If the wax is not evenly coated inside, a lot of peculiar trouble takes place with the music produced. A musical box should never be placed near a fire.

Now, for an offer. Once before, in 1942, I offered to lend my cam-turning jig for "1831" to anyone who wrote to me and paid postage both ways. Quite a large number of people took advantage of this. Mr. Westbury may remember it. I have a number of scrap cylinders for musical boxes which I am prepared to loan out on the same terms for people to practise on, provided they do not waste the wax, as someone else may want to knock a few pins out! Heaven help them!!

People should be able to see from the stamps how much it has cost me to send the cylinder. I would be glad of letters telling me how they got on.

I am glad you are collecting information on a once flourishing art, as very shortly, unless something is done, all knowledge of the repair of musical boxes will be forgotten.

Yours faithfully,

Leamington Spa. H. A. J. LAWRENCE.

DEAR SIR,—In reply to your SOS in "Smoke Rings," dated October 11th. I believe I can supply the necessary information your correspondents require.

Many years ago I had in my employ a very clever mechanic and clock repairer, the clock repairing was really a hobby of his and a side line. In the course of things he occasionally had a musical box to repair.

One day he confessed he was stumped, as he had to practically re-pin a 12-tune cylinder and up to that time he had meticulously drilled out the faulty pins and *screwed* in the new ones, but he definitely did not like the idea of all the work entailed in pinning a full cylinder. He asked my opinion about it and I suggested he was tackling the job in a wrong manner by screwing in the pins. After a little discussion and argument I said why not take out one end of the cylinder and have a peep inside. He did, and solved the problem. *The pins are short lengths of piano wire of correct gauge pushed through the small holes into the cylinder with a fair length of wire remaining inside, the cylinder is then warmed up and filled with a kind of resin.*

I trust the above will enable fellow repairers or would-be repairers of musical boxes to carry on O.K.

Yours faithfully,

Mansfield. J. B. S. POYSER.

Old Engines

DEAR SIR,—It is with much interest that I have read the articles by "The Dominie," in your paper. There cannot be many of your readers who can remember one of the original partners of Maudsley, Son and Field. Telford Field was one of my father's greatest friends; and I, as a small boy, well remember his visits.

There was also a model with a vertical cylinder, mahogany lagged of about $2\frac{1}{2}$ in. stroke with all the elaborate trimmings shown in your drawings. Where the model is today I do not know, I have never seriously thought of it for over 50 years. The drawings of these old engines have raised many almost forgotten memories.

The story of Naysmith's steam hammer, which was first produced in Maudsley's, is one that I can well remember.

Yours faithfully,

Pietermaritzburg. C. M. G. COMPTON, Major, I.A., Retd.

Oscillating Cylinder Winches

DEAR SIR,—I was interested to read the letters in THE MODEL ENGINEER on the above subject, which took my mind back to the years 1920 to 1930, when I was a fitter at a colliery on Tyneside, where these engines were very widely used for hauling coal trains in the workings. They were run on compressed air at 80 lb. per sq. in., and gave very good service indeed. There were several of different sizes going by the name of Wards Patent haulage engines; the smallest, as near as I remember, was called "Baby," and was provided with a clamp fitting, so that it could be clamped to a prop supporting the roof. It had cylinders 3 in. bore, and one rope drum. They all had two cylinders with disc cranks, and dog clutches to disengage the drums. They ran in either direction and were controlled by means of a specially designed throttle like a large plug cock in the centre casting of the engine. The larger engines had two drums so that they had a rope on each end of the train and were called "main and tail haulers." In this way they could control a train maybe half a mile away from the engine, using bell signals in the same way as a colliery winding engine. The engines had catalogue names as follows:—Baby, Willie, Ajax, Samson & Hercules, and varied in size accordingly, the largest having cylinders about 10 in. bore.

Yours faithfully,

Huddersfield. E. B. HUNTER.

Steel Boilers

DEAR SIR,—In reply to Mr. Chittock's letter in THE MODEL ENGINEER, September 13th, referring to the model tug of mine with the coal-fired steel boiler, I am glad to say that both it and myself are still in one piece after its fourth season's running, the last time being at the St. Alban's regatta, as noted in your journal. However, a few observations on this boiler might be of interest to other readers.

In the first place, it was made as an experiment. No details were forthcoming of other model boats having coal-fired boilers, same being not very popular apparently with the power boat fraternity.

The design was chosen for its simplicity, and it was decided to make it of available steel plate, so that in the event of it being no good, no great loss would be involved and some other design could have been tried out.

However, the boiler turned out to be a great success, and although I originally intended to make another in copper, time has so far prevented me doing so. After reading Mr. Chittock's letter though, a red light flashed! "Had this boiler had its day?" I asked myself, and so I decided to dismantle it for examination. Now, rust shows in the water used in the boiler, only a jet black sediment, but, on cutting out a piece of the plate from the side, it revealed that it was indeed badly pitted and had flaked as well; and, although there still remains an appreciable amount of metal, I feel the time has come to do something about making another in copper.

I shall not alter the design in any way, as this boiler has proved that it is possible to use coal-firing in prototype boats with every success, its most important feature being, I think, the method of firing it from the top, one can thus keep the fire going without removing any of the deckwork.

Yours faithfully,

East Barnet. F. W. THOMAS.

Utility Petrol Engines

DEAR SIR,—May I extend my thanks to Mr. E. W. Fraser for his most interesting reply to my letter published in THE MODEL ENGINEER on May 17th.

I must admit that I thought my letter had fallen on "stony ground," that no one was interested in workshop engines; however, the knowledge that i.c. wizard Westbury will be describing the horizontal engine exhibited on the "M.E." stand at the last exhibition shows that things are looking up.

Mr. Fraser may be interested to know that beside me as I write, lies a copy of THE MODEL ENGINEER for August 10th, 1939, open at page 181, which carries two artist's sketches of his workshop at Luton, and shows the Hartop horizontal engine to which he refers in his letter. It looks a most attractive workshop.

It has been facetiously suggested to me by local club members that I might care to revert to wind or water power! But I must confess that they appear to be "Highly Efficient" model engineers, who measure the workshop in terms of how quickly and easily a job can be done. That form of model engineering is not for me. The satisfaction of being in an interesting workshop, surrounded by interesting machinery is of greater value to me than purely workshop efficiency.

I like to see things working, to see what makes them "tick"—the "tick" of an electric motor is not a very satisfying thing.

Yours faithfully,

Bristol. A. SMITH.

Refrigerators

DEAR SIR,—I would like to compliment Mr. Gray on the excellent appearance of his refrigerator, which appeared in a recent issue of THE MODEL ENGINEER, and while in no way wishing to criticise, I would like to offer a few useful suggestions.

When a system is to be opened up by removal of coil, compressor, etc., it is usual to pump to a low vac., thereby placing all the liquid gas into the receiver. The liquid discharge valve is then "cracked" allowing a small charge of liquid to expand through the system until 0-lb. pressure is reached. There being pure gas only, the compressor may be removed complete with suction valve (for testing) without losing gas or drawing in air—remembering, of course, to seal the open suction line with tape meanwhile.

With regard to the interior lining, hard plaster-board of the type to be found in a butcher's cabinet is much better than aluminium, although it doesn't look quite as good. An oxide formation will soon dull an aluminium shell if it is not well looked after and often wiped out. An afterthought—to cut plaster "Stipple-board" make a groove in the glazed side with a sharp scriber. Place on a flat surface with the line parallel with the edge. A light pressure and it is off!

In my duties as service engineer I have found F.12 gas (now made in England as "Arston 6") to be a great deal less troublesome than methyl chloride. Although needing a slightly more robust compressor unit owing to the higher working pressures, there is much less tendency for valves to frost up, etc.

It is a good plan if a second-hand unit is to be used to scrap any filters, driers, etc., and to purchase new ones—this expense will be amply repaid in trouble-free running. Next, remove the compressor head and sump without disturbing shaft seal or discharge needs (once upset they are unlikely to be gas-tight). Flush with carbon tetrachloride and reassemble. Next, flush the receiver after purging off gas: The original charge will probably contain a corrosive element owing to contamination by moisture. Protect each part after cleaning by sealing ports, etc. until ready for use. Viscosity 150 refrigeration oil is the recommended grade for filling up.

The usual workshop method after a seal or valve plate has been lapped and the compressor needs running in, is to close both valves, fit connection in both service parts and attach a crossover line. It can now be run for hours if necessary without any fear of moisture causing damage, as it assuredly would if pumped to and from the atmosphere.

Yours faithfully,

Leeds. J. WHITE.